THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXXII. No. 1853.] LONDON, NOVEMBER 15, 1898. [50TH YEAR. PRICE 6d.

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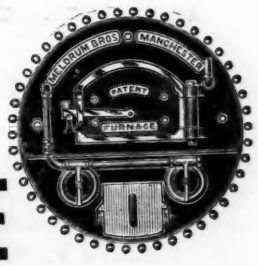

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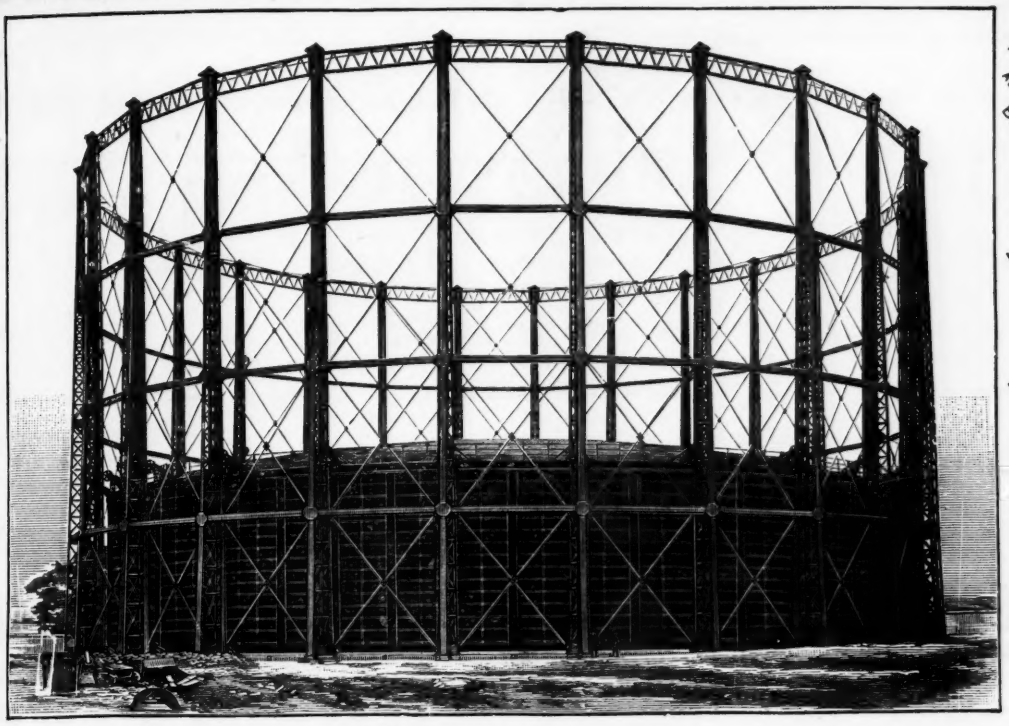

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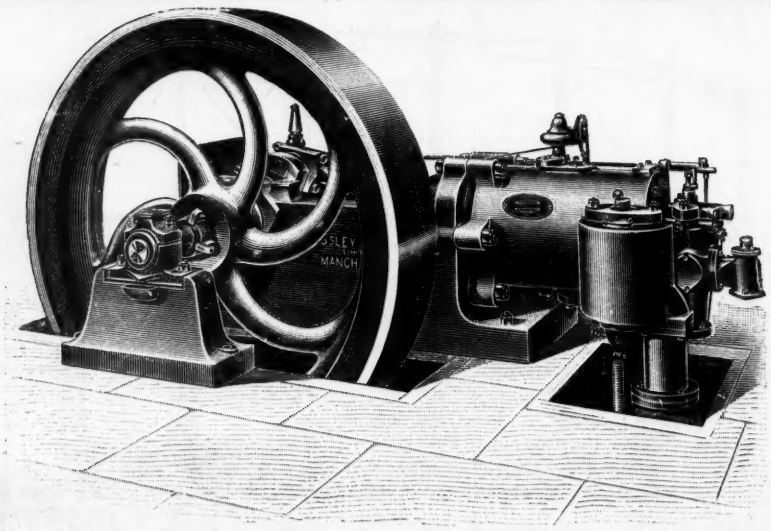

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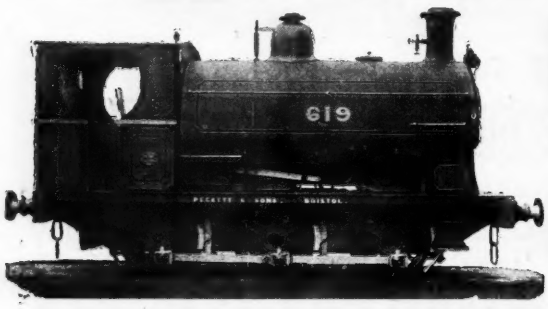

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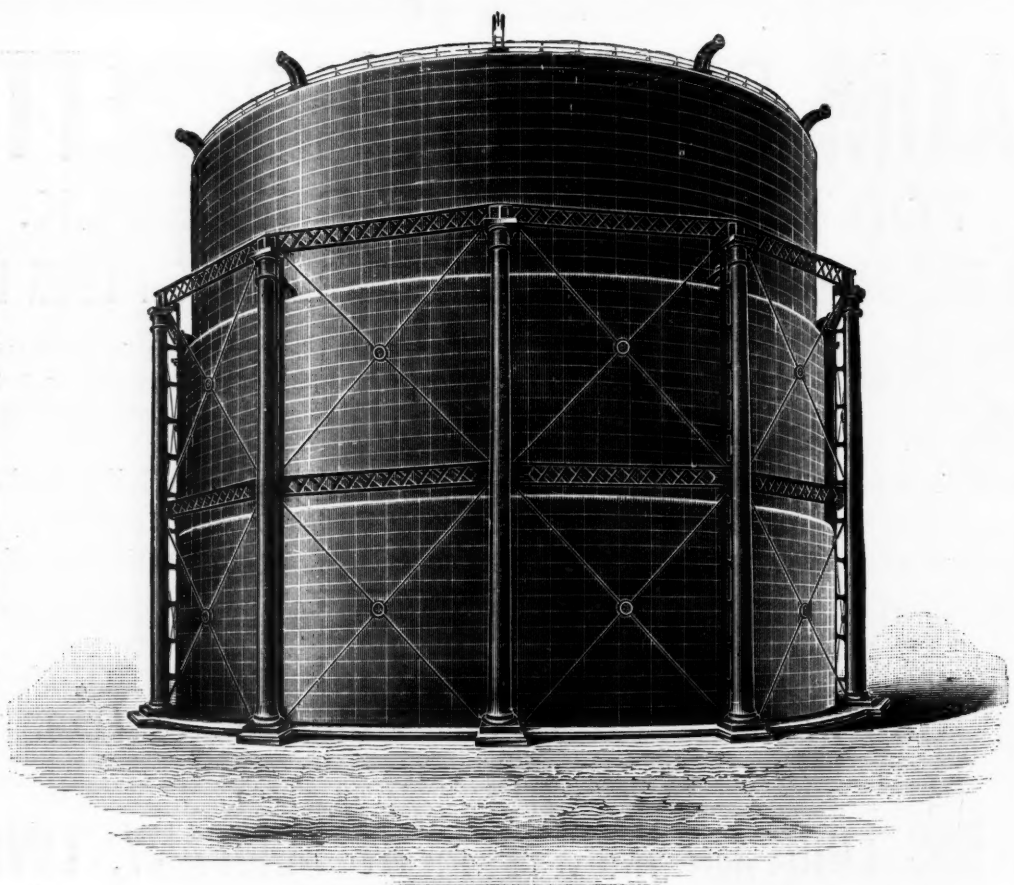

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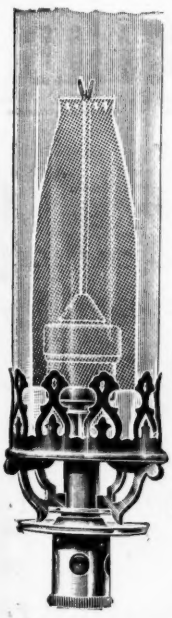

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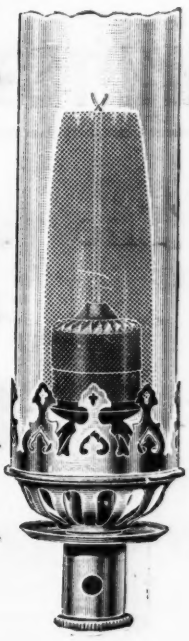

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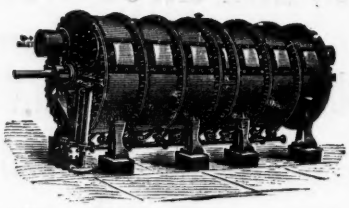

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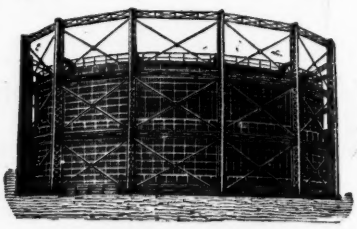

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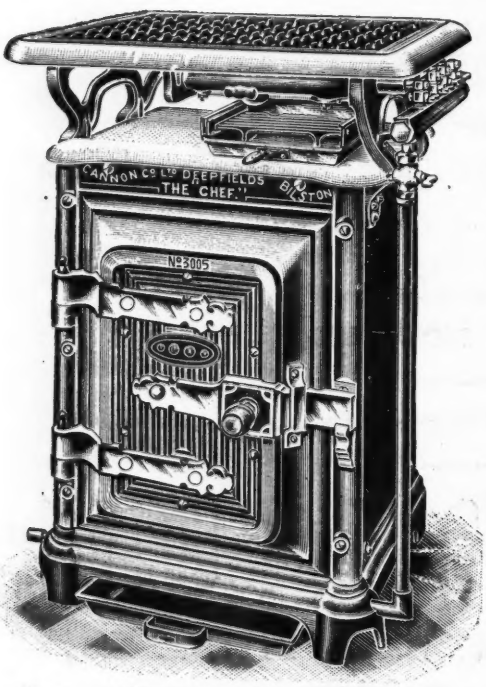

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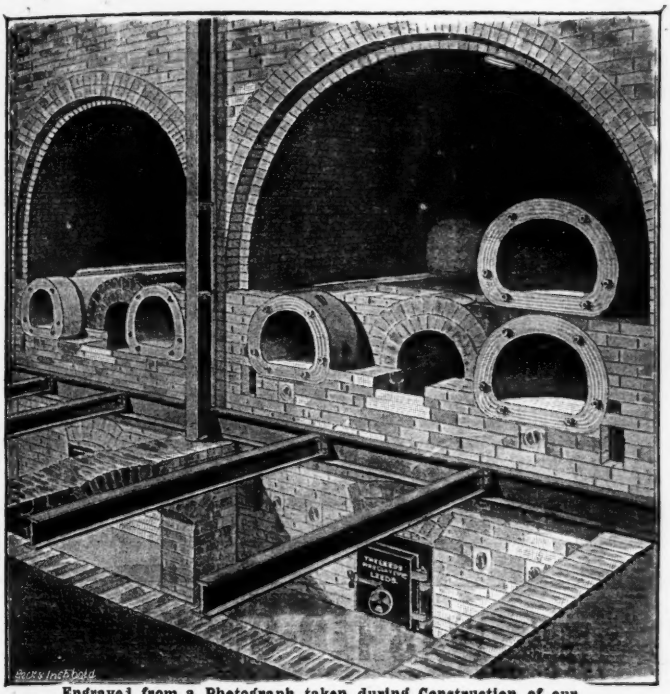

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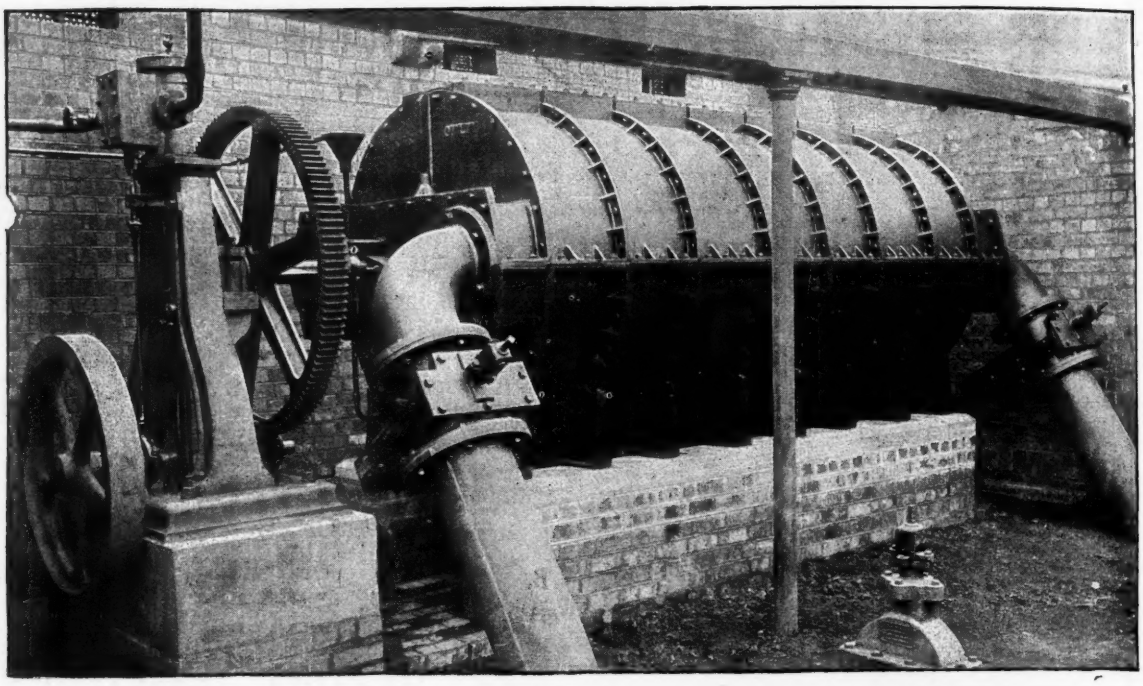

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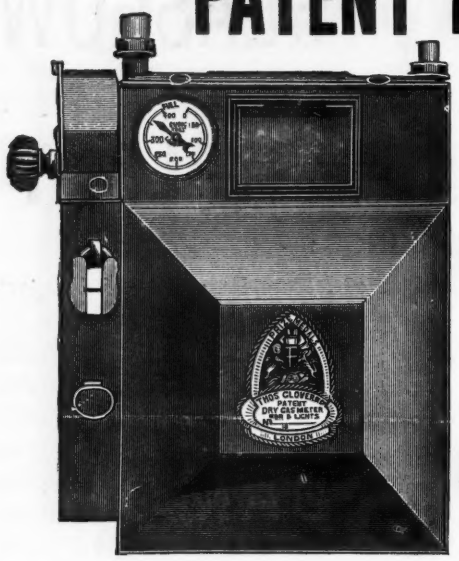

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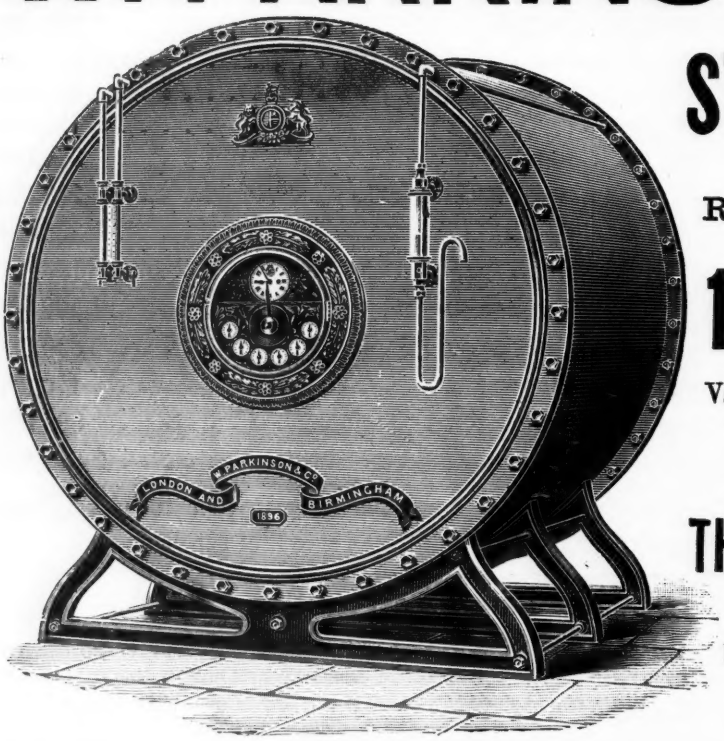

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EDITORIAL NOTES.

The Proceedings of the Southern District Association of Gas Engineers.

THE Southern District Association met on Thursday last, under the presidency of Mr. R. Beynon, of Torquay, who will be followed in the chair by Mr. A. E. Broadberry, of Tottenham. It is to be hoped that the new President and the Committee will be able to smarten up the proceedings of the Association next year; for it has appeared to well-wishers of the organization that an air of lethargy has crept over it of late which greatly needs shaking off. It is a quiet time just now with the District Associations generally, owing to the fact of there being nothing stirring in the technic of gas manufacture. Inclined retorts, mechanical stoking, and carburetted water gas are old topics now; and gas managers have little left to dispute about. So far as it went, however, the spice of controversy was not absent from Thursday's proceedings.

The so-called "carburation" process for the prevention of naphthalene deposits in the district, as originated and applied at Hastings by the Messrs. Botley, father and son, was brought upon the carpet once more, with the object of proving its practical success by the citation of further experience since the process was described to the Institution of Gas Engineers in May, 1897. The authors are to be complimented on their perseverance; and they cannot be denied the credit for having made out so good a case for their process that the responsibility for not trying it now rests heavily upon gas managers troubled with their own old complaint. The mental attitude of gas managers in regard to the naphthalene evil would afford a curious study for a psychologist. Such of them as are familiar with the nuisance are loud in complaint of the worry which it causes them; but tell them of a remedy, and so far from expressing gratitude, the probability is that they will shake their heads over the suggestion. The moment a gas manager who has been a sufferer claims to have delivered himself by the adoption of some process, all the others turn upon him, and in their hearts revile him for a "quack." The Hastings process is at least a clear and intelligible operation, capable of being described in much simpler language than the authors prefer to indulge in respecting it. Mr. Botley said on Thursday that it consists in "the treatment of the gas going into the district from the "outlet of the governors by adding an oil mist to it, en-"veloping the gas in an oily atmosphere, through which it "is protected throughout its canalization, whence it passes "to the burners." The description would have been less open to question if it had stopped at the first comma. It is only inviting criticism to talk of enveloping gas in an oily atmosphere. This is contrary to the fact. It is the gas which constitutes the atmosphere, and the oil fog is borne by it, exactly as sea fog is carried by the air. It is Mr. Botley's contention that the result of the addition of this oil fog to the gas in the distributing mains was to soften, and cause to disappear by absorption into the gas, ancient naphthalene deposits wherever found; and further to prevent the deposition of any more naphthalene anywhere. Mr. Botley's sharpest critic—Mr. J. W. Helps, of Croydon—declares his inability to see any reason why the process should effect anything of the kind. The Messrs. Botley rejoin that the fact remains, which is quite enough for them.

Here, it seems to us, they had better rest, and let somebody else make the next step. There is no getting over the evidence that since the process has been in use at Hastings the total number of stoppages in the district has fallen from 4948 in 1893, to 485 in 1898, notwithstanding the increased bulk of gas sold and of consumers' connections. This is a matter of the office complaint-book, which cannot be gainsaid. Mr. Botley ascribes the beneficial result to the operation of the "carburation" process; and this is the strength of his case. When he goes beyond, and attempts to explain how it is done, as by suggesting the creation by the oil mist of an "artificial vapour tension" in the gas-mains, he makes a mistake. We suppose it to be true, by the way, that the oil used is actually a solvent of naphthalene at the ordinary temperatures. Stress was laid, and very properly, upon the phenomenon of the large deposition of water that attends the addition of the oil fog to the gas. Delicate thermometric experiments at this point might throw some light upon what goes on in the

circumstances. Some young student of gas manufacture anxious to "win his spurs" by an original paper, might do worse than address himself to the task of wresting the physical secret from this remarkable phenomenon.

Mr. W. B. Randall's paper was a very useful contribution to contemporary technical literature; and it went to show how valuable the aid of instruments may be in raising the standard of practice in the direction of precision. Two comments are suggested by the paper. The author says: "It is very remarkable how some soils have the "power of deodorizing the gas." This is not a novel observation; but the hint it gives has never to our knowledge been followed up. Is it the fact that certain soils do deodorize coal gas? If so, what is the active principle in the operation? If such a principle were isolated, it might prove effectual in deodorizing the exhaust of gas-engines and the chilled products of combustion which are apt to give so much annoyance when gas-fires are first lit up. There is a use for something of the kind. The other observation refers to Mr. W. A. Valon's point that gas managers had better resign themselves to the steam-roller and the traction-engine, which have "come to stay." It is unquestionably true; and though an audience of gas managers may sympathetically cheer a brother manager's complaint of the cruelty of traction-engines to gas-mains, the wiser among them will see in the moving tale a warning to put their pipes beyond the reach of injury. The laying of small gas-mains in country roads has often been scandalously scamped in days gone by. The local marine store dealer knew more than he was likely to tell about the ganger's "perks;" and the gas manager of the present day has to correct the faults committed in an earlier, but not more guileless era.

The Latest Trade Union Ideals.

It is not an uninstructive, while it is often an amusing, occupation to test societies and classes of mankind by their acknowledged ideals. As practice inevitably falls short of profession in the individual, so achievement never amounts to 100 per cent. of a Party programme. If it did, there would be nothing left to fight and organize for. Of all the militant societies that exist by virtue of the Englishman's inherited reforming spirit, and his growing preference for having his work in this kind done for him, there are very few that would not regard with dismay the immediate realization of their declared objects. Where would the estimable Peace Society be if the sword everywhere were actually converted, if not into the reaping-hook—these implements being superseded by machinery—at least into the British policeman's staff? In order to keep a reforming society going, a good serviceable ideal is necessary—something not too remote to arouse enthusiasm, but not in urgent risk of realization. It is understood among a certain section of the public that the cause of Trade Unionism is a great and good one. They profess to see in it the only hope for Labour (with the capital letter); and it is therefore incumbent upon students of their own times to ascertain what are the ideals of this kind of organization. It should not be open to question that the most trustworthy intelligence in this regard is to be procured from the official declarations of the Parliamentary Committee of the Trade Union Congress. Mr. S. Woods, M.P., the Secretary of this Committee, has just issued a "manifesto"—precious word!—in which the latest Trade Unionist "charter" is formulated. Consequently, we now know what organized Labour wants.

Its requirements are: The reduction of the qualification for voters to the lowest possible point; the removal of the cost of registration to the public funds; that parochial relief shall not involve disfranchisement; the abolition of plural voting; and the payment out of the public funds of returning officers' fees in parliamentary elections. This is enough for one mouthful; but it is difficult to see where "Labour" comes into such a hack politicians' hotch-potch. Next comes the demand for a Bill providing for the separate valuation of land and improvements, for the assessment of taxation and rates upon the full true yearly value of land, whether in use or not. "Labour" not yet in sight! The next point is the payment of members of Parliament, "as in most other countries." Now we are "getting warm," as the children say. In the following claims, we eventually reach the spot. These are for the extension of the Workmen's Compensation Act, so as to include all trades and industries on land and sea, and to remove the safeguard of the first fortnight. Also, for a "better administration "of the fair wages resolution passed in the House of "Commons in February, 1891, so as to provide for a "minimum wage of 24s. a week for labourers in the "various Government Departments;" for compelling the Government contractors to pay "standard" wages; for a miners' Eight-Hour Bill; for Board of Trade investigation into cases of alleged victimization of railway services; for the passing of Mr. Samuel's Steam-Engines and Boilers (Persons in Charge) Bill. Well may the most perfervid Press advocates of the Trade Union cause feel they have been "sold" over this paltry trifling with the issues of Labour politics. What has become of the forty-eight hour week; the hours of labour of women and children; the shortcomings of the Truck Act; old age pensions—and a hundred other things that the organized British Workman is supposed to be in need of? Said we not truly the other week that an extra quarter of an hour for breakfast would be worth more to British workmen than all the "resolutions" of all the Trade Union Congresses that have ever been held? In this manifesto of Mr. Woods, M.P., the cheap professional politician is first, and the working man, who actually works, is nowhere—to say nothing of the woman and the child. Why, the old Trade Union cry for the "Three Eights" was immeasurably beyond it in every respect. If this proclamation gives the ideals of Trade Unionism, then its prophets had better "step down and out."

Mr. J. B. Crockett on the American Gas Industry.

The Presidential Address of Mr. J. B. Crockett, President of the San Francisco Gas and Electric Company, to the American Gaslight Association, on the occasion of the recent meeting at Niagara Falls, was briefly mentioned in last week's "Journal." The different conditions under which the gas industry of the United States is carried on, as compared with those prevailing in this country, have often been the subject of comment in these columns. Mr. Crockett's address was a luminous exposition of some of the most important of these differences. The question of municipal ownership of gas undertakings, for example, has bearings of a totally different nature in the two countries. Mr. Crockett shows his perspicacity as a man of business by brushing aside the cobwebs of *pseudo*-scientific analysis of the question, from the American standpoint, and placing in the forefront the evidence, gathered from our news columns, that gas consumers in English cities where the gas-works are municipalized are not getting their light any cheaper than those in cities of the same size supplied by Gas Companies. This is a hard nut for the theorists of municipalization to crack. At the present juncture, when even Municipalities in the United Kingdom are being very much exercised over the prospects of cheap electric power transmission, it is interesting to hear what Mr. Crockett has to tell us on the subject. Speaking within sound of the Falls of Niagara, and coming from California, where long-distance electric power transmission plant is at home, Mr. Crockett uttered words of reassurance and comfort. He freely admitted that these large systems have, in some instances, inflicted a very great deal of hardship on small local Companies, but stated that "the cost of equipping "and maintaining an electric plant for long trans-"mission, the high initial voltage required, the line and "converter loss sustained, and the high cost of construct-"ing storage dams to ensure a full supply of water during "a dry season, have caused this system of lighting to be "looked upon with more or less disfavour." Mr. Crockett's conclusion is "that long-line transmission will not at "present hurt the gas business." Descriptions of these power-transmission plants look formidable in technical literature; but "the Receiver" is a very real bogey in the American industrial world, although engineers do not often mention him. As regards the effect of the trolley-wire system of tramway working upon gas mains and services, Mr. Crockett again speaks with the authority of all the experience there is—which is the American. When the first electric trams got to work, the distribution plant of the San Francisco Gas Company began to suffer from electrolysis. Steps were taken to prevent the mischief; but it is the President's deliberate judgment that the process of deterioration from this cause is still likely to go on. He does not take an alarmist tone in regard to the danger, but is quite resigned to its existence. Let the electric tramway be never so well laid and bonded, there will be

leakage of current in places. The comparatively great mass of the gas and water pipes will attract some of the return current at these weak places, and corrosion will take place even when the voltage of the escaping current is so low as not to deflect the needle of an ordinary station voltmeter. This is the prospect which British gas engineers in their turn will have to face, if other objections to the overhead trolley-wire system are overcome. Mr. Crockett is to be congratulated on his excellent address.

The Origin and Development of the Prepayment System.

In another part of the "JOURNAL" will be found the first of a short series of articles on the above subject, by Mr. E. W. T. Richmond, the appearance of which in our columns seems to call for a few explanatory remarks. In common with everybody engaged in the business of gas supply, Mr. Richmond had been struck with the extraordinary development of the prepayment system since the introduction of Mr. Brownhill's meter placed in the hands of gas managers another means of extending their business; and a few months ago it occurred to him that an interesting article might be written tracing the gradual adoption of the now popular "penny-in-the-slot" arrangement in connection with the sale of gas. But, as in the case of other historians, he found that the writing was the smallest part of the work; the difficulty lying chiefly in the collection and arrangement of material. However, starting with all the published matter available, and encouraged by the cheerfully rendered assistance of gas managers on all hands, he commenced his task; and as he proceeded he found that the work grew under his hand. He nevertheless went steadily on; and the result of his labours will come before our readers in this and succeeding issues. With regard to the form in which the matter is presented, it was, of course, open to the author to make his story a dry record of facts and figures. He preferred to adopt a much lighter style; and however foreign it may be to the columns in which it appears, we venture to think the author's data will be none the less interesting from the fact that they are interspersed with evidences of research in another field than that of strictly technical literature.

The Reform of Company Promotion.

The Lord Chief Justice of England took advantage of the ceremonial introduction of the new Lord Mayor to Her Majesty's Judges on Wednesday last for the delivery of an eloquent—even impassioned—diatribe against the evils of the joint-stock company system. This is no new fancy on the part of Lord Russell of Killowen, who has on former occasions declared himself to be an enemy of the fraudulent company promoter and all his works. This last pronouncement began with due acknowledgment of the good effected by the principle of trading with limited liability. It has enabled that to be done by honest co-operation of the many which could not be done by the unaided efforts and resources of one or a few; but it has been abused by the unscrupulous few. The chief abuses of the system enumerated by the Lord Chief Justice are over-capitalization, misrepresentation as to the value of the property concerned, going to allotment on insufficient capital, and the "one-man company" fraud. Much of the evil done under these categories could not happen if directors were what the law supposes and intends them to be—namely, honest, independent, and capable men of business. The mischief of over-capitalization is one of degree; and some degree of it is probably unavoidable from the very nature of the joint-stock company system. The promotion of companies is not a missionary enterprise. Somebody must undertake the work, and be paid for it. The curious thing is that this business remains unrecognized. You shall look long in a Directory before you discover the name of anybody so classified. Yet, why not? One can sympathize with the artless young foreigner, Charles William Siemens, who, when he brought over his and his brothers' first invention—the water-meter, that bears the family name—walked into the office of an "undertaker" in the belief that this was a place where his business would be done. Why should not those men of affairs who "undertake" the flotation of joint-stock enterprises hang out their sign to this effect? It would at least be open and above-board. A prospectus might bear the notification that the company was being promoted by Mr. Blank, at whose office every information that intending investors might reasonably ask for would be supplied. The investing public might as well pin their faith to Mr. Blank as to the name of anybody else seen upon the front page of the prospectus. The British public have paid dearly for their experience of the secret promoter. They might try the overt plan in a few instances. Something will have to be done to help in the curing of the great and crying evils described and discussed by the Lord Chief Justice. The joint-stock system is part and parcel of the industrial and commercial life of the community; and great as have been its effects, there are even greater results to follow, so soon as the co-operation of the small investor is recaptured. It should not be beyond the wit of man to devise some means of working the system without the fraudulent promoter and his dummy directors at one end, and the venal financial Press at the other.

WATER AND SANITARY AFFAIRS.

The Royal Commission on the London Water Supply held two sittings last week, and a third yesterday; the subject under consideration being that of intercommunication between the works of the different Companies. We referred last week to the statement by Mr. Pope, Q.C., that the Companies were prepared to undertake the duty of promoting a Bill next session for the purpose of connecting the different systems of supply in the Metropolis. According to the evidence of Mr. Ernest Collins, the Distributing Engineer to the New River Company, the cost of carrying out the scheme was estimated at about £307,000; but there was another plan, in which, by utilizing certain works intended to be abandoned by the Southwark and Vauxhall Company at Battersea, and laying a main to Battersea from Hampton, a very good centre of distribution could be obtained, possessing certain advantages. The total cost of the mains and connections in this case would be about £255,000; but, in addition, there would be the cost of purchasing or renting the Battersea works. This scheme had not then been considered by the Boards of Directors, but it was said to have the support of all the Engineers. At the sitting of the Commission the following day, Sir Henry Knight, the Chairman of the Southwark and Vauxhall Company, said he did not consider either of the plans put forward on the previous day to be absolutely necessary; and he suggested a more modest scheme, capable of being carried out at a cost of £25,000 or £30,000, which would meet all the needs of the East London Company. Sir Henry explained the general attitude of the Water Companies by saying they felt it necessary to adopt some scheme of intercommunication such as that which was to cost £307,000, in order to "satisfy the public outcry." Other witnesses officially connected with the Water Companies gave very similar evidence—approving of a large plan for linking up the mains, but intimating that it was not really wanted, and would seldom or never be used. It was simply devised to meet the popular cry. Lord Llandaff remarked that the result of the evidence went to show that nobody wanted the works, and so nobody should bear the cost of them.

The position in which the London Water Question now presents itself is assuredly singular to the extent of being absurd, and we may even say mischievous. Popular clamour, excited by a party in the County Council, has taken such effect on the Companies that the latter come forward with a proposal to expend £300,000 for something which is entirely unnecessary, and which they know to be so. The Distributing Engineer of the New River Company offers evidence in favour of such a project, and then gives it as his private opinion that the works are not wanted. The Chairman of the Commission thereupon observes that, according to the evidence, the Companies have pledged themselves to go for a Bill in Parliament to carry out works which are "absolutely superfluous." It is evident that the East London Company can have their wants supplied with a very moderate addition to the expenditure which has already taken place. But a demand has been put forth that all the systems of supply shall be connected; and there is to be a clause to carry out this view in the Purchase Bill which the County Council are about to bring into Parliament. The Council refused to promote a separate Bill for the purpose of connecting the mains of the several Companies, but tacked this project to their purchase scheme; the certainty being that no relief could be afforded to the East London district by such a plan, till after the expiration of the coming summer, when no such relief would be wanted. The Companies are providing that East London shall be secure against any restriction

of its supply when the summer heats are again prevalent. Beyond this they propose a larger scheme, costly in itself, but simply on all-fours with that which the Council desire to carry out when they take the place now occupied by the Companies. At this juncture, what says the organ of the Progressives to the action of the Companies? As a primary argument it is declared that the Water Companies should not be allowed to spend more capital while the prospect of purchase is so near at hand. Of course, nothing is to be done to improve the water supply, or in any way to satisfy public feeling concerning it, so long as the Companies remain in possession. The very operation which the Council have advocated, and for the non-execution of which the Companies have been blamed, is now condemned in so many words as an obstructive measure intended to support Lord Onslow against the Council. One feature in the plan proposed by the Companies is very distinctly objected to, though it may prove to be of great value at particular times. It is proposed that the Local Government Board shall have power, in case of emergency, to authorize any of the Companies to take more water from the Thames than they are now allowed to draw. This seems a very reasonable provision, and one quite in accordance with the interests of the public. If London wants more water for a brief period, is London not to have it? Would not such a denial be a worse restriction than that of which so much complaint has been made in respect to East London? What will the County Council do to meet London's demand for water during the ten or fifteen years which are to intervene before the Welsh aqueduct is in operation? With respect to the Welsh supply, our information of a few weeks ago, that the mountain streams are seriously affected by the deficient rainfall, is thoroughly supported by a letter in "The Times" of yesterday, the communication being evidently from a writer well qualified to speak. It is stated that during the recent drought the stream principally relied upon to supply the reservoir of the County Council's Welsh water scheme "was completely dried up for a month." In another letter Sir A. Binnie is stated to have told the Select Committee on the Staines Reservoirs Bill that "no new water "power" was required for the present supply of London.

The question of connecting the different water systems in the Metropolis has now assumed a magnitude which few outside the official circle of the Companies could have anticipated. When the Commission resumed its sittings last week, the Chairman showed his sense of the situation by saying he proposed to deal first with "the separate "and small subject of the inquiry—namely, intercom-"munication between the different Water Companies." It now appears that, if all the supplies are to be connected, the "small subject" will be a matter of debentures to an extent exceeding a quarter of a million. If this occasions surprise, we may also suppose the County Council to be caught unawares, by being placed third in the race on the subject of intercommunication. Their project for connecting the different systems is practically strangled by the dead-weight of the purchase scheme. The Companies come forward with a Bill which is free from any entanglement, while over and above all there is the evident determination of the Local Government Board that there shall be prompt legislation of some kind or other to connect the different systems of supply, even if they bring in a Bill of their own. The County Council must now contemplate the risk of being superseded on all that relates to the East London question, for it is utterly unlikely that the Government will allow a Bill to pass which couples with that subordinate topic the actual purchase of all the water undertakings of the Metropolis, unless, indeed, meanwhile there comes a report from the Royal Commission adopting the County Council's view that inter-communication between all the Companies is necessary for East London's sake, and can only be accomplished by letting the Council buy up all the concerns. Such a conclusion, if arrived at by the Commission, would be exalting the "small subject" into a position commanding the entire field. After all, the mountain might well bring forth a mouse; the result being the adoption of a plan something like that proposed by Sir Henry Knight. This would suffice for the passing hour, and perhaps for a little longer. Yet there is the risk that even the Commission and the Government may be so pushed as to feel, like the Companies themselves, that it is necessary to do something big, in order to "satisfy the public outcry."

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 1118.)

THE markets in the Stock Exchange opened last week still dominated by the shy feeling which marked the close of the week before. Caution was the order of the day; and business remained very quiet. Gradually, however, a better state of feeling crept in; and after the delivery of the Premier's speech at the Guildhall on Wednesday, a pronounced sense of relief was felt. Prices rose freely as operators found it expedient to buy back. Apart from home politics, the defeat of the silverites in the United States elections gave the American market a fine lift. The Stock Exchange settlement was light and easy; so that influences were favourable all round. The Money Market was easier; and Stock Exchange requirements were too slight to create any demand. Business in the Gas Market has at last shown a little more animation; and transactions approached something more resembling a normal level. Changes in quotations were not numerous or considerable; but the general tendency indicated was in the direction of easier prices. In Gaslights, the "A" was fairly active on most days of the week. Opening at 290, it soon began to show symptoms of shrinking, which ruled till the close, when the last mark was 287½, and the quotation had lost a couple of points. The secured issues too were not very firm; but the only actual decline was in the 10 per cent. preferences. South Metropolitan was moderately dealt in at rather easier prices; but the quotation stood still. Nothing to speak of was done in Commercials. The Suburban and Provincial was only noticeable for a few dealings in issues which are not often in the market. Good prices were commanded; but quotations did not move. Business in the Continental Companies was unimportant. Imperial was most in evidence; and the tendency was not quite so strong—the quotation being a point weaker, after allowing for the dividend. But the 3½ per cent. debenture gained a point. There was nothing calling for particular remark in connection with other undertakings. Water was quite stagnant; transactions being of the slightest, and quotations not undergoing any change.

The daily operations were: The opening day was not very brisk for Gas. Transactions were mostly in Gaslight "A" at the old figures; and the quotations did not vary. Tuesday's business was more evenly distributed over the list; but it was not heavy. Prices ruled easier—Gaslight "A" and Imperial receding 1 each; and Hong Kong, ½. Wednesday was quite a quiet day (owing partly to the Lord Mayor's Show), and nothing moved. Activity revived to some extent on Thursday. Gaslight "C," "D," and "E" fell 1; but the actual price marked showed no falling off. Friday brought a further shrinkage of 1 in Gaslight "A." Saturday's business was of its usual proportions; and no changes were marked.

ELECTRIC LIGHTING MEMORANDA.

Reappearance of Mr. Tesla—Power Transmission Without Wires—The Theory—The Objections.

AFTER a prolonged interval of silence, Mr. Tesla has broken out again, and the newspapers were last week once more charged with high-tension articles inspired by the projected triumphs of this Austro-American "wizard." For, indeed, Tesla seems to have quite superseded Edison in the capacity of the great medicine man of electricity. It is so long since the "Wizard of Menlo Park" was heard from, that he must be supposed to have retired from the wonder-working branch of his business. The magazines even have ceased to find the name of Edison attractive of stray sixpences and threepennies. It was very different once upon a time, and that not a great while ago. Mr. Edison was understood to be prepared to abolish war according to the old ways of fighting; and when the almost forgotten difficulty about Venezuela was in its acutest stage, he was widely reported to be perfecting a system whereby the President of the United States should be able to destroy the British fleet wherever it might be, by the simple process of pressing a button in his cabinet. The United States have actually been at war since then, although not with this country; and it must have been a disappointment to the students of Edison prophetic literature, to discover that after all the war had to be finished by fighting in the crude old bloodthirsty manner. There was none of the button-pressing trick in the Cuban business; but the rough, earnest fighting men simply fought and died just as though Edison had never existed. Now that there is no more fighting to be done, Mr. Tesla takes the opportunity for announcing that he has a system of electrical power transmission whereby everything in this line that Mr. Edison, wizard (retired), did not do can be easily accomplished, "and more too."

A more sober account of Mr. Tesla's method appears in the current number of the "Electrical Review." It turns out to be a proposal to transmit electric power without the intervention

of any metallic line conductors, by taking advantage of the conductivity of the layer of rarefied air existing in the higher regions of the atmosphere. In order to effect this purpose, special apparatus has been devised for the production and conversion of exceedingly high electrical pressures. Tesla accordingly claims to have accomplished, with safety and ease, the generation of electrical pressures measurable by millions of volts. In the course of these investigations, certain unforeseen ancillary facts were discovered. Among them is the discovery that with electrical pressures of the magnitude and character which Tesla has been able to produce, the atmosphere becomes in a measures capable of serving as a true conductor for transmitting current. Also, the conductivity of the air increases so materially with the increase of electrical pressure and the degree of exhaustion, that it becomes possible to transmit through even moderately rarefied strata of the atmosphere electrical energy up to practically any amount and to any distance. In order to carry out his system of power transmission, Tesla begins by employing special apparatus capable of generating electrical pressures vastly in excess of anything previously heard of. By way of showing that such apparatus exists, our contemporary publishes a view from a photograph of a model Tesla transformer or "oscillator" in action—very much so, in fact, inasmuch as it is the originating centre of "luminous streams," or sparks, covering a width of 16 feet and of the "estimated" pressure of 2½ million volts.

The transmitting arrangement for use in connection with this artificial lightning apparatus would be a balloon, maintained at an elevation where the atmosphere would be sufficiently rarefied to be capable of conducting freely the particular kind of current produced. At any distant point where the energy is to be utilized, a corresponding terminal is provided at the same elevation, which would receive the current for conveyance to earth and suitable conversion there to useful purposes. Of course, the whole thing is very prettily demonstrated "diagrammatically," and all the essentials have been worked out, upon paper. The phenomenon of transmission in this way is one of true conduction, and is not to be confounded with the phenomena of induction or of electrical radiation which have heretofore been observed and experimented with, and which, from their very nature and mode of propagation, would render practically impossible the transmission of any considerable amount of energy to such distances as would be of practical importance. This is all very clear and plain. The first criticism that suggests itself is as to whether the scheme differs from any other of the electric firework devices with which the name of Tesla has been associated. Our electrical contemporary admits that the suggestion rests upon a basis of fact which is sound enough so far as it goes. It is true, that is, that the resistance of air to the passage of electricity gradually decreases, with diminution of pressure, until a minimum is reached; and then there is an increase, possibly to infinity, as the exhaustion of the air approaches absolute vacuum. Since the pressure of the atmosphere diminishes with elevation, there must be a height at which the conductivity for electricity is at the maximum. What Tesla is actually proposing is to utilize the stratum of greatest conductivity for his outgoing lead; the earth being employed for the return.

The first question to be asked is, Where is this desirable stratum of the atmosphere, and how is it to be reached? The reply to the inquiry is not encouraging. Schultz has measured the conductivity of air at different pressures, and found that the maximum conductivity existed at a pressure of about 0·1 mm., when it was about a thousand times that of air at the ordinary pressure. A stratum of air at a pressure of 0·1 mm. does not exist naturally nearer than 30 miles above the earth's surface, where it is obviously out of reach. But Tesla claims that with his high tension currents the air behaves differently; which would absolve him from the necessity of going to the region of greatest conductivity. But wherever he goes, the vertical height must be very much less than the horizontal span; and there must thus be a tendency of the current to travel by the shortest road, which in this case would be in the vertical direction. Whatever else Mr. Tesla may be able to do, he can hardly expect to make electricity travel otherwise than along the line of least resistance. However, the prospect held out by this latest announcement is a fascinating one, and not to be dismissed as wholly chimerical. If Mr. Tesla keeps on long enough, he is likely to do something practical at last; and if he turns his attention from artificial lighting without wires to power transmission under the same condition, his goal may be nearer.

Experiments on Mixtures of Acetylene and Air.—We have received from Mr. F. Grover, Assoc.M.Inst.C.E., M.Inst.M.E., of Leeds, a copy of a pamphlet giving particulars of some experiments carried out by him on the pressures and explosive efficiency of mixtures of acetylene and air. He explains that in cases where acetylene gas has been employed as motive power, the proportions of air to gas have been calculated from the cylinder volumes and the volume of gas which passed the meter. This method might lead to erroneous conclusions; and it was with the object of examining more closely the behaviour of acetylene gas applied to explosion engines that Mr. Grover made his experiments.

THE STRIKES AND LOCK-OUTS OF 1897.

THE report of the Chief Labour Correspondent of the Board of Trade on the Strikes and Lock-Outs of 1897 was briefly mentioned in a paragraph in last week's "JOURNAL." It has furnished the newspapers with matter for reflection which has been utilized in a variety of characteristic ways. Last year was troubled by some very serious labour disputes, the chief of which was the outbreak of the Society engineers. It has become the rule of the Labour Department of the Board of Trade to determine the importance of an industrial dispute by multiplying the number of workpeople thrown idle by the number of working days over which their idleness extends. This is probably the best way of measuring the disturbance; and if it is systematically carried out year after year, it furnishes statistics of real relative and approximate actual value. Tested by this means, 1897 was a bad year as regards the aggregate duration of disputes, but one of the lowest as regards the number of workpeople involved. Looking back over these strike statistics for several years, it is possible to draw certain inferences respecting the industrial movement. For the last five years, no disputes of any magnitude were reported among agricultural labourers, seamen, or firemen; and it is impossible to dissociate this quiescence from the total collapse of the Trade Union movement in these classes of workpeople. On the other hand, the occupations in which there is most organization—mining and quarrying; metal, engineering, and shipbuilding; and textile trades—furnished by far the largest number of disturbances. These statistics may be commended to the notice of those public speakers and newspaper writers who affect to believe that Trade Unions do not encourage strikes. Yet, after all, the number of workpeople involved in disputes is very small as compared with the total numbers employed, "except, perhaps, in the case of coal mining." When politicians and others talk about the danger to British trade supremacy through the prevalence of strikes, they should be reminded that even last year, with the engineers out on the war-path, not more than 2 per cent. of the working population was involved in dispute with employers.

An interesting point brought out by an analysis of these strike statistics is the great magnitude of a few of the trade disputes in this country in recent years. For several successive years there was one great strike, in one trade or another, every year. In 1893, it was the federated miners; in 1894, the Scottish miners struck to the number of 70,000; in 1895, the boot and shoe trade was in revolt; 1896 was void of such exciting incidents; but in 1897 came the turn of the engineers. Statesmen have a habit of saying that in matters political the English people can only attend to one thing at a time; and this national trait appears in connection with industrial outbreaks. It might be a curious inquiry as to what would happen if all these workpeople went on strike simultaneously. Such, we know, has been the dream of the professional agitators of the unpractical German socialistic school, who have more than once tried to bring off the stupendous phenomenon of a "universal strike." But the trick has been too artificial. The British workman is not averse to striking when it suits him to "play" instead of work; but he does it on his own account, and it somehow happens to come "turn and turn about."

Most industrial disputes, as this report again shows, are over questions of rates of wages. Disputes over hours of labour come next for the past year, because of the inclusion of the engineering strike under this head; but ordinarily it is a minor source of trouble. The engineers' strike might also have been included under the heading "Working arrangements." As regards wages, 1897 was a good year for trade, and consequently for pay. On the whole, the disputes were settled in the majority of instances in favour of the employers. Small strikes, for increases of wages, went generally in favour of the men; labour being in great demand, especially in the building trades. A melancholy exception to the general rule is the case of the Welsh tinplate manufacture. The value of tinplates and the volume of the trade reached their maximum in 1891, since when there has been a heavy decline in both. Meanwhile, the men have endeavoured to maintain the list of piece prices settled in 1874; while the masters have tried to increase the output or else reduce the rates of pay. The result has been continually recurring disputes, accompanied by the closing of many mills "more or less permanently." Thus it is shown once more how difficult it is for trade societies to accommodate themselves to bad trade conditions.

The chief interest of the report naturally centres in the special account which it gives, in nine pages, of the great engineering dispute. Knowing the Trade Union proclivities of the Department, which confessedly draws all its figures from Society sources, we were curious to see how the official chronicler, himself an ex-Secretary of the Amalgamated Society of Engineers, would treat this catastrophic chapter of the history of his old Society. The story commences by admitting that for some time back the relations between the organizations of employers and employed in the engineering trade "had been unsatisfactory, and it was becoming evident that, at almost any moment, serious complications might arise." Then it is recounted how trouble originated through the arbitrary conduct of the Amalgamated Society of Engineers with regard to the employment of men belonging to other Societies to attend to machine tools. The movement for

obtaining a general eight-hour day in the London district was started early in the year; and in its earlier stages it was confined to this one object. But when the parties found themselves engaged in a struggle for mastery, however, other and more real questions came to the front; and the dispute involved the settlement of workshop control and the limits of Trade Union interference. It has never been known how far the effects of the strike extended. Even now the report declares it is not possible to give precise information as to the number of men directly and indirectly affected by it. The aggregate number of days lost is computed at 6,849,000; and perhaps 50,000 workmen in all lost time over it. The full text of the settlement signed on Jan. 28 are given. The chronicler passes over without comment the failure of the Board of Trade to conciliate the parties. The report certainly gives the impression that the work of the Department has now subsided into a purely statistical groove.

MECHANICAL TRAMWAY TRACTION.

SECOND ARTICLE.

THE prospects of gas-power tramway working should be brightened by what has immediately transpired upon the publication of Mr. J. Allen Baker's report. We cannot complain of Mr. Baker's guarded observations upon the system; but it is imperative that his comments, which carefully stopped short of a conclusion, should be read in connection with the letter of Mr. T. C. Hersey in the "JOURNAL" of the 1st inst., and Mr. Howard Lane's letter which appears in our Correspondence columns to-day. We are content to rest the case for gas traction, at present, upon Mr. Lane's weighty observation, that "if a self-contained motor tramcar is ultimately forthcoming which will be efficient, economical, and unobjectionable in its working, there are most important reasons why the question of its adoption should receive favourable consideration from all municipal authorities." Mr. Lane confesses that the unfavourable report of the Birmingham Corporation deputation is not conclusive, which is all that need be said about it. The chief considerations to be borne in mind by anyone who would undertake to judge the relative and absolute claims of the various systems of mechanical traction now before the world, are fairly indicated by Mr. Lane. It may not be superfluous to state that the origination and progressive development of gas-power tramway traction have been chronicled in the "JOURNAL" for several years past.

It must be counted as meritorious in Mr. Baker that, although he allows it to appear that he does not think there is much in gas-power tramway working—or he would surely have discussed the idea at greater length, and illustrated his story with at least a drawing of a car and its mechanism—he does not, as already acknowledged, pronounce judgment against the system even as he knows it. Mr. Baker does so condemn steam and oil motors as applied to tramcars, which may appear rash if regard is had to the desperate contemporary attempts to place motor vans upon the streets in France and England. In the "Engineer" of the 28th ult., there appear illustrations and descriptions of heavy motors cars of four different types, examples of which actually participated in the second annual road trials just held in the vicinity of Paris. It is a little hazardous for even the most confident believer in electrical traction to disregard this evidence that the steam and oil road motor is not yet dead. He may be justified in regarding these things as already condemned to failure; but unhappily for him those who are interested in the road motor business do not submit to his judgment. The plain man, who is no expert, may be pardoned for feeling bewildered when Mr. Baker assures him, on the one hand, that steam tramcars are "out of the race," and that oil tramcar motors have proved both "unsuccessful and unpopular;" while, on the other hand, there are the Automobile Association and others to assure him that this is a complete mistake.

A pause may be conveniently made here in order to introduce a consideration that should not be lost sight of—that is to say, the question of the road surface. A steel rail such as is used for a tram-line is only a small piece of very hard, smooth, and easy road surface. If the whole road surface were similar to it, physically, most of the difference between a tramcar and a common road car would disappear. As matters exist for the present in regard to road surfaces, this consummation is not to be compassed. But it is a little remarkable that just when, as Mr. Baker says, steam and oil power haulage are being abandoned on the easy tram-line, they should be forced more than ever into prominence for service on the more difficult common road. Is all the "Automobile" movement of the day mere imposture and advertisement? Is the road motor car, heavy or light, really coming into use upon its merits? If the latter query can be truly answered in the affirmative, there must follow a revival of the experimental application of the same methods of traction to tramways. If the "Leyland" road van proves itself a success, why not a "Leyland" tramcar?

It would unduly expand these articles to examine such questions thoroughly; and we shall therefore dismiss them for the time being with the mere expression of opinion, offered for whatever it may be worth, that the motor road car has not yet "arrived," as the French say. With all the good-will in the world, we cannot take the "Automobile" performances seriously, nor believe that it is in these machines to supersede horse haulage. Let us then return to the consideration of tramway working, with faith in Mr. Baker's *dictum* that steam and oil are out of the running. There is nothing in what this authority advances, to show that gas power is in the same case. Of course, the electricians, whatever their own particular predilections, are unanimous in dismissing "gas-trams" as impossible. Thus the "Electrician" inquires "wherein has gas power shown its superiority over electric traction?" and supplies the answer, "Certainly not in point of numbers of lines, mileage of track, commercial success, or popular approval." It is magnanimously conceded that "gas-trams will work, after a fashion," and they might even be made to pay; "but in no respect can they be regarded seriously as a possible competitor of the electric car." This is all very well as an exercise on the theme "there's nothing like leather;" but it is very little more. Electricians need reminding over and over again that English people will not be "bull-dozed" into accepting the overhead trolley wire, because it happens to be the system of tramway working with which American cities by the score have had to put up. The "Electrical Review" is far more candid in recognizing the strength of the case for gas traction that has been put forward in consequence of Mr. Baker's report. It observes that "the gas traction system would undoubtedly move ahead rapidly, were it not that the public are in an expectant mood as regards electrical working, and the way is being blocked by the municipalities." This is very much to the point. The enormous expansion of electric traction in the United States has had the effect of creating the impression that in this kind of mechanical power lies the tramway working "of the future"—just as in the department of artificial lighting, electricity has for twenty years been going to provide the "light of the future." And, similarly, as the Belfast Corporation and others were afraid of making sufficient provision for the growth of their gas undertaking, lest it should all be waste of money and pains, so the tramway interest of the United Kingdom has been frightened away from everything besides the trolley wire. Nobody likes the trolley-wire system—not even the electricians; but it is advertised as the best that electricity can do, and therefore the world is expected to be content with it. Electricians need persuading that this is no recommendation. Tramway and electricity supply companies cannot buy British municipalities as they bought the city authorities of the United States. This is the chief feature of the actual situation. The reason why the overhead trolley-wire system of electric traction for tramways has not yet achieved its thousands of miles of line in the United Kingdom is that it has to come in here, if at all, upon its merits; and these are not numerous or good enough to carry it very far, or into good neighbourhoods.

It may here be remarked, in passing, that Mr. Baker's report notices "compressed air" among possible sources of mechanical power for working tramways. It is obvious that a compressed air motor car must share many of the advantages and disadvantages of a gas-car, with the addition of several drawbacks peculiar to itself. Cable trams are *sui generis;* and need not be discussed at length by us. Mr. Baker hurries over all these "provisional" systems of tramway working, and arrives at electric traction as offering the most acceptable solution of the mechanical problem. This is precisely what is to be proved, not taken for granted. Mr. Baker follows the partisan, not the natural method of demonstration. He announces his conclusion first, as where he says: "I think there can be no doubt that in solving the problem of the haulage of our tramways, we must look to some form of electric traction." And again: "There can be no doubt that the best and cheapest mode of tramway traction to-day is electric." The natural way would be to establish the facts first, and draw conclusions from them afterwards. His method only provokes criticism. Why, it may be asked, should the world accept the blessed word "electric" as closing the chapter of tramway working in the current chronicle of mechanical achievement? Should not the expediency of electrical as of other kinds of tramway working or machine driving be proved in the usual way? Let us test the case presented by Mr. Baker as though the word "electric" were exchangeable, say, for "hydraulic" power.

Mr. Baker's first claim runs: "It has been proved in scores of cities in America and on the Continent, as well as in this country, that the cost of operating by horse traction is from 50 to 100 per cent. greater than by the electric system; while the latter has been proved to be more economical than any form of mechanical haulage." This should follow, not precede, the proof. If it were done in the former way, it would be a demonstration; as it stands, it looks more like a prejudice. Mr. Hersey, in his letter above referred to, has dealt with the specific advantages put forward for electric traction, without regard to system, by Mr. Baker; and he shows that these either do not exist, or are not peculiar to the method of working. We shall not follow Mr. Baker in his digression from the question of system to the subject of fares. It is more to the point to see what he has to offer in the shape of description or comment upon the various forms in which electric traction can be realized. These are four in number, and comprise (1) accumulator, (2) surface contact, (3) overhead wire with trolley or slide connection, and (4) underground conduit with sliding or rolling connections.

With regard to traction by accumulators, there is now little

to be said. The endeavour to drive tramcars by means of stored electricity has broken many hearts and blighted many prospects. Mr. Baker says "theoretically the accumulator system has much in its favour, inasmuch as there is no underground construction in the streets required nor any overhead wires, while each car carrying its own electric energy is an independent unit." He might have said as much for the gas-car, with more hope of realization. When it is seen, however, that a duly equipped accumulator tramcar of the ordinary size weighs 10½ tons without passengers, the theoretical beauty of the principle becomes obscured by cold practical considerations. Moreover, even so the accumulator car will not always go. Actually, the best that has been done with accumulators in this way is to enable trolley-wire trams to cross busy centres of traffic which could not otherwise be negotiated without the humiliation of hitching on a team of horses. This makeshift arrangement is in operation in Brussels, Berlin, and some other Continental cities; and it is doubtful whether it is to be esteemed as complimentary to the accumulator principle, or scandalizing to the trolley wire.

This leads us to the second, or "surface contact" system, which must be reserved for another article.

THE "ROBERT HUNTER FUND."

First List of Contributions.

In response to the appeal made in last week's issue of the "Journal" (p. 1027), contributions to the amount of £72 11s. 0d. have been received—as per list below—and we trust that during the present week the sum will be considerably added to. It will be remembered that this fund is quite distinct from that being raised by the Manchester District Institution of Gas Engineers, who are receiving contributions from their own members only; and it was started to give those outside this limited circle an opportunity of testifying their regard for one who was for many years widely known and greatly respected apart from his professional friends of Lancashire and Cheshire with whom he had been more particularly identified during recent years.

FIRST LIST.

	£	s.	d.
Cross, Mr. Samuel, Abergavenny	1	1	0
Donald Macpherson and Co., Limited, Manchester	10	10	0
Helps, Mr. George, Bath	1	1	0
King, Mr. Walter, Bolt Court, E.C.	5	5	0
Livesey, Mr. Frank, South Metropolitan Gas Company	3	0	0
Macpherson, Mr. D. D., Manchester	10	10	0
Mildred, Mr. Matthew, Bankside, S.E.	21	0	0
Randall, Mr. James, Tottenham	2	2	0
Richmond, Mr. E. W. T., Warrington	5	5	0
Sainsbury, Mr. H., Trowbridge		10	0
Smith, Mr. G. (late Reporter for the Manchester District Insitution of Gas Engineers)	1	1	0
Southern District Association of Gas Engineers and Managers	5	5	0
Thomas, Mr. Hanbury, Sheffield	5	0	0
Wadeson, Mr. James, Windsor	1	1	0
	£72	11	0

[Contributions may be forwarded to Mr. Walter King, at the Offices of the "Journal."]

PERSONAL.

Mr. J. C. Hale, of Ruthin, has been appointed Manager of the Goring and Streatley Gas-Works.

Mr. Robert M. Couper, who for some years has been Manager of the Newbury Corporation Gas-Works, has tendered his resignation, and intends, it is believed, removing with his family to Scotland.

Mr. J. H. Lloyd has been appointed Chairman of the Gas Committee of the Birmingham Corporation, in succession to Mr. Alderman Pollack, who has vacated the position under circumstances which will be fresh in the recollection of our readers.

Mr. G. B. Tonge, Secretary of the Driffield Gas Company before the undertaking was transferred to the Urban District Council, has been presented with a testimonial in the form of a solid silver salver, in recognition of his gratuitous services as Liquidator of the Company.

Mr. T. Greaves, who has retired from the management of the Melton Mowbray Gas Company, has been presented by the employees, who were recently entertained by him at dinner, with a writing-desk, accompanied by a drawing-room timepiece for Mrs. Greaves. The presentation was made by the Chairman of the Company, Mr. J. Glover.

Last week it was announced in this column that Mr. Alexander Allan had been appointed Engineer and Manager of the Chester Gas-Works, in succession to the late Mr. Robert Hunter. We now learn that Mr. Allan has since reconsidered his decision to go to Chester, and has withdrawn his resignation of the position he held at Sheffield as Superintendent of the Neepsend Gas-Works.

Among the new Provincial Aldermen just elected are Mr. J. Lowden, Chairman of the Gas Committee of the Leeds Corporation, and Mr. T. Speight, the retiring Mayor of Bradford, who holds a similar position in the Corporation of that town. In connection with aldermanic elections, we notice that Alderman Garnett, the Chairman of the Gas Committee of the Clitheroe Corporation, has retired into private life. The loss of his services in this capacity to the town are referred to regretfully by a local paper.

The list of Mayors for 1898-9 contains, as those for previous years have done, the names of several gentlemen closely connected with gas and water undertakings. The new Mayor of Bacup, Mr. Ben Smith, is Vice-Chairman of the Water Committee of the Corporation. Mr. C. G. Beale, who has been re-elected Lord Mayor of Birmingham, has done good work on the Gas and Water Committees. Mr. J. Lewis, the new Mayor of Carmarthen, has been a Director of the Gas Company for several years. Dr. R. Parry, who has been again chosen for the Mayoralty at Carnarvon, is Chairman of the Gas Committee of the Corporation; and Mr. F. Geen, who fills a similar position at Stoke-upon-Trent, has also been re-elected. At Falmouth, Mr. C. Deeble, who has taken a conspicuous part in connection with the gas and water works purchase question, will continue to hold office. At Honiton, Mr. R. H. Matthews is a Director of the Gas Company. Mr. J. Marshall Thomas, the Engineer of the Penryn Gas Company, retains the mayoralty. The Mayor of Shrewsbury, Mr. T. P. Deakin, has for a long time presided over the deliberations of the Gas, Water, and Lighting Committee of the Corporation. At Swansea, Mr. R. Martin took an active part in the negotiations for the purchase of the gas-works, and has been closely identified with the new water-works at Cray, the commencement of which was noticed last week. The new Mayor of Wakefield, Mr. G. H. Roberts, is a Director of the Gas Company, as well as of the Ardsley Gas Company. Mr. R. H. Hodgson, who has been elected Mayor of Workington, is Chairman of the Water Committee of the Corporation and also of the Workington Joint Water Committee.

OBITUARY.

The recent death is announced of Mr. R. Birkett, one of the founders, and up to the last a Director, of the Morecambe Gas Company.

We regret to record the death last Friday, at Boulogne, in his 48th year, of M. Guillaume T. P. J. Mertens, Manager of the Roubaix Gas-Works. Deceased was a member of the Société Technique de l'Industrie du Gaz en France, having been admitted in 1884.

The death is announced of M. de Meritens, whose name will be familiar to some of our readers in connection with his magneto-electric generator, which was tried about twenty years ago in many French and several English lighthouses for illumination purposes. He was 65 years of age, and died in very reduced circumstances.

The death occurred on the 27th ult. of Herr Otto Reissner, the Engineer of the Municipal Gas-Works at Berlin. He was in his 67th year, and had been in the municipal service for upwards of forty years, and for more than thirty years had charge of the gas-works, in the growth and success of which he took the deepest interest.

A well-known German gas engineer—Herr Carl Brandt—died recently at Magdeburg, in his 73rd year. The earlier part of his life was spent in several branches of engineering; but from 1853, when he constructed the Magdeburg Gas-Works, onwards, he devoted himself almost exclusively to the construction of gas-works. He designed and erected those supplying many of the small towns in Germany as well as in neighbouring countries.

The last number of the "Journal des Usines à Gaz" contains a notice of the life-work of M. Emile Coze, of Rheims, whose death has lately taken place. He entered the service of the Continental Union Gas Company in 1857; but two years later he was appointed Superintendent of the St. Mandé station of the Paris Gas Company. He left the city in 1893, at the request of M. Vautier, to take the management of the gas-works at Rheims, which he reconstructed. He carried out, in conjunction with friends, an amalgamation of the Soissons and Epernay Gas Companies, and thus formed the nucleus of a group of thirteen works constituting the Société Anonyme des Usines à Gaz du Nord et de l'Est, of which he was Managing Director. Leaving to his son, M. André Coze, whose name is so well known in connection with the inclined retort system, the management of the works at Rheims, he devoted himself to the development of the Company he had formed. He found time, however, to attend to outside matters, and constructed for the Ottoman Bank the gas-works at Beyrout. He was one of the early members of the Société Technique du Gaz en France, and served on the Committee in 1874-5. He was also on the quinquennial Gas Commission nominated in the year 1885 by the Minister of the Interior.

NOTES.

The Conditions of Working Under High Air Pressure.

A curious example of the way in which the new law of employers' liability for compensation to workmen injured in the course of their employment is likely to develop strange working conditions, is afforded by certain proceedings at Brussels. An international conference has been sitting there to settle the limits of safety working under compressed air—a matter of great and growing importance for all modern engineering constructors, seeing how largely the method is used in sinking in wet ground. Both engineering and medical science were represented at the conference; and as a result several leading principles were laid down. It was decided that men over 50 and under 20 years of age are unfitted for working under a high air pressure; while in any case medical certificates should be required as to the condition of the heart, lungs, and vascular system. An ear affection, a temporary cold, or a gastric attack, should be obstacles to this employment. The limit of air pressure under which men can safely work is fixed at 75 lbs. per square inch, corresponding to a depth of 170 feet of water. In such extreme cases, it is necessary to give ample time for returning to ordinary atmospheric pressure—say, one minute for every 1½ lbs. of maximum pressure. It is suggested that when going through an alteration of air pressure, men should suck sugar, which ensures the swallowing of the saliva, and prevents injury to the tympanum.

Blast Furnace Gas as a Motive Power.

It is often stated that a blast-furnace is a typical gas-producer, and that if the gas thus made could be fully utilized, the pig iron simultaneously produced would be a bye-product. In order to procure reliable data as to the power of blast-furnace gas for working engines, the Cockerill Society placed at the disposal of Professor Witz their furnaces and a 200-horse power "Simplex" gas-engine, of the make of Delamare-Deboutville and Malandin. This motor had a single cylinder 31·5 inches diameter and 3·28 inches stroke, and was adjusted to work with a charge compressed to 108 lbs. per square inch. The trial run lasted for 24 hours; and the gas was taken from blast-furnaces running in the ordinary way. The engine was kept running at a velocity of 105 revolutions per minute, developing 181·16 brake horse power. The load was so disposed that 10·7 per cent. of the possible ignitions were missed, so as to have a margin of power in hand. The consumption of gas was after the rate of 117·6 cubic feet per brake horse power per hour. The calorific value of the gas worked out on the average to 110·2 British thermal units per cubic foot; so that it was to be regarded as fair but rather poor producer gas. The temperature of the exhaust ran up to 896° Fahr., although there was a flow in the cylinder jacket of 15·87 gallons per horse power per hour; the water leaving the jacket at a temperature of 92·7° Fahr. It is evident from this test that there is a large available supply of power in this form in localities where iron is made; and the French and Belgian ironmasters are likely to take full advantage of the circumstance.

Steam Raising from Dust-Bin Refuse.

Mr. George Wilkinson writes to the "Engineer" a long letter from Harrogate upon steam raising from the combustion of towns' ash-bin refuse. He begins by challenging the general method at present in vogue for burning this refuse, by the agency of so-called "destructors," which he characterizes as very inefficient for producing useful steam power from the resultant heat, and involving a capital outlay out of all proportion to the useful return. Owing to the sluggish operation of destructors, they are unwieldy; and by reason of the impossibility of controlling the rate of combustion, they are inapplicable to the purpose of steam raising where the demand is variable. Attempts have been made, says Mr. Wilkinson, to obtain the necessary flexibility of adjustment by the addition of an expensive and complicated system of "thermal storage;" but he is responsible for the statement that at Shoreditch (the most notable example of the kind) the results have not been satisfactory, and the apparatus is not being used. The author describes a destructor which is claimed to be the fruit of extended trials and experience. The chief feature of this apparatus is a long iron chamber forming a prolongation of the boiler-flues, in which the screened refuse is exposed to the heat of the furnace gases. Here it is dried and prepared for burning in the enlarged grates of ordinary Lancashire boilers. Thus treated, the dust of a North of England town was found to have an evaporative power of 3·06 lbs. per pound of the dry and prepared fuel portion of it. Mr. Wilkinson claims that with this system, as a mean of experiments made with refuse from different towns, 1 lb. of water was evaporated per pound of crude refuse; while in brick-built destructors, the consumption varies from 3·3 lbs. of refuse at Oldham to 9·7 lbs. at Eastbourne per pound of steam generated.

More New Elements.

At the British Association meeting, there were several introductions of new comers into the list of the elementary substances of which the earth and its atmosphere is known to be composed. The President (Sir W. Crookes) had the honour of performing the first of these interesting functions. He stated in his address that M. and Mme. Curie have discovered a new constituent of the uranium mineral pitchblende, which in a 400-fold degree possesses uranium's mysterious power of emitting a form of energy capable of impressing a photographic plate and of discharging electricity by rendering air a conductor. It also appears that the radiant activity of the new body, to which the discoverers have given the name of polonium, needs neither the excitation of light nor the stimulus of electricity. Like uranium, it draws its energy from some constantly regenerating and hitherto unsuspected store, exhaustless in amount. Is "the light of the future" to be procured from the same source, when its nature is ascertained. Sir W. Crookes thinks that something of the kind is possible, for he remarks that "the store drawn upon naturally by uranium and other heavy atoms only awaits the touch of the magic hand of science to enable the twentieth century to cast into the shade the marvels of the nineteenth." Sir W. Crookes himself followed this speculation by announcing his discovery of a new body belonging to the rare earth group, which he calls monium. Though only caught by the searching rays of the spectrum, this element offers a direct contrast to the recently discovered gaseous elements, in possessing a strongly marked individuality, and a readiness to enter into any number of chemical alliances. Before the Chemical Section Professor Ramsay and Mr. Morris W. Travers described how they found the new gases neon, krypton, metargon, and a still heavier gas not previously described, which exists only in minute quantity, and is named by the authors xenon.

COMMUNICATED ARTICLES.

SLOT COOKERS AND ALL ABOUT THEM.

By E. W. T. Richmond.

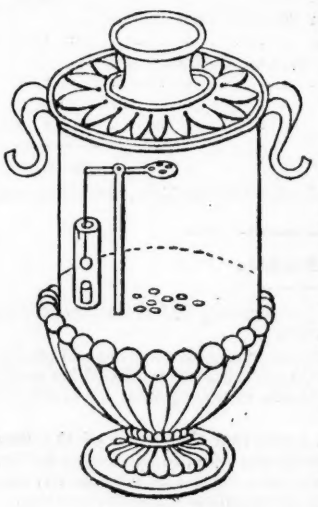
"An age when all our daily wants,
Whether they be but few or many,
Will be sufficiently supplied,
By merely dropping in a penny."
"Truth," April 14, 1898.

Although the system of supplying various commodities automatically on a deposit of a coin in a receptacle—commonly known as the "penny-in-the-slot" system—is regarded by many as essentially a *fin-de-siècle* product, we must go very much farther back than the present century to find the first instance of its employment. It was supposed by some to have been introduced by a certain free-thinking publisher—one Richard Carlile—who lived between 1790 and 1843; but, in fact, it existed hundreds of years before that. Indeed, it was known some time before the Christian Era; and its invention may be attributed to Hero of Alexandria, in whose "Pneumatics" is described a sacrificial vessel which flowed only when money was introduced. Truly there is nothing new under the sun. It appears frequently to be our lot to adapt to our present needs, and give precision to, what after all are the inventions of the ancients. In truth—

Richard Carlile.

Hero of Alexandria.

"Our inventions meet and jump in one."
"Taming of the Shrew," Act i., Sc. 1.



Hero's Vase.

From the accompanying illustration it appears that the mechanism was very similar to that of the modern automatic machine. When the coin was dropped through the slot, it fell on one end of a horizontal beam, which, on being depressed, opened a valve suspended from a chain at the other end, and the wine commenced to flow out through a pipe. When the beam had been depressed to a certain angle, the coin fell off and the valve or lid, being counter-weighted, again descended and closed the outlet so that the discharge ceased.

Rumour has it that centuries before Hero, the prepayment system was introduced by priests in the Eastern temples to bring tears to the eyes of their gods. This they accomplished in the following ingenious manner: When the devotee placed his offerings upon some portion of the image (or upon the altar or platform upon which the image stood), the weight of the offering acted as a lever, and opened a valve in one of the cellars of the temple. This cellar contained a sort of apparatus for hot water; and the action of the valve caused steam to ascend, through metallic or bamboo tubes, to the eyes of the image, and, condensing there, the steam became transformed into tears—the object, no doubt, being to impress the devotee, and probably induce him to increase his contributions to the temple.

In more recent times, the "penny-in-the-slot" arrangement was most frequently seen with working models at industrial exhibitions, and at some of the popular seaside resorts. Not a few of those who read these lines will probably remember the childish curiosity aroused when they were told, somewhat in the language of the world-renowned librettist, that

"If you want to move the lot,
Put a penny in the slot;"

and the intense delight with which they keenly looked for the movement of the figures as the result of parting with the coin, as illustrated below.

BEFORE!

A ROW OF AUTOMATIC MACHINES ON FOLKESTONE BEACH, SUPPLYING CIGARETTES, SCENT, SWEETMEATS, ETC.

AFTER!

We have only to look around, and we at once see to what a variety of purposes the penny-in-the-slot arrangement has been applied. The supply of sweetmeats, cigarettes, cigars, matches, eau-de-cologne, postage stamps, post cards, or writing paper, are among the most common; while toothpicks, miniature playing cards, hair-pins, and hot water, &c., from lamp-posts, are the most recent developments in this connection. The very latest was announced in the "Daily Mail" of the 10th inst., when Mr. Alfred J. Faulding, of Abchurch Lane, London, stated his intention to instal 1000 "penny-in-the-slot banks" throughout London—in the principal streets, at railway stations, factories, and schools—his idea being that thousands of persons, who at present have no convenient means of "fastening up" their odd coppers, will drop them into the "Slot Bank," and obtain a receipt by turning a lever in the usual way. These receipts can, when required, be presented at a Central Bank, and left on deposit at 2½ per cent. interest, or they may be realized at any time.

SLOT SAVINGS BANKS.

MR. BROWNHILL AND MR. F. LIVESEY, 1888.

Probably the most useful adaptation of the system was witnessed in 1888, when Mr. Brownhill, of Walsall, introduced his meter, by which gas could be supplied in pennyworths. Mr. Brownhill's invention was encouraged by Mr. Frank Livesey by the ordering of a number of sample meters, which were fitted in some new houses in course of erection close to the Old Kent Road offices of the South Metropolitan Gas Company. They were, however, not a success. John Stewart Wallace, however, a year previously—in 1887—first patented (No. 1620) the essentials of the present system, but in a crude form, although it has been held by experts that he did not contemplate the supply of gas in his invention.

MR. J. S. WALLACE, 1887.

MR. W. E. PRICE, HAMPTON COURT.

Within six months of Brownhill's patent came Mr. Price's invention, which has been considered as one of the few master patents governing the remarkably fine family of apprentices that sprang up anxious to do their master's work in some other, and, if possible, better manner. Twelve months after the date of Mr. Price's specification, he read a paper, entitled "Some Hindrances to the Sale of Gas," at the Southern District Association meeting in November, 1888, and followed Mr. Brownhill's example in the Midlands, by exhibiting his early prepayment meter effort. This paper will repay perusal; it has proved prophetic. The deposit system is severely handled, and the remedy shown. "We have no reason to suppose," says Mr. Price, "that the artisan has any hereditary love for the tallow dip or paraffin lamp," and provided that gas is supplied on the "pay-as-you-go" plan, he predicts an enormous increase, perhaps "too sudden to be yet appreciated."

The discussion on the paper proved that a veritable Daniel had "come to judgment;" Mr. W. H. H. Broadberry, of Tottenham, being distinctly "down" on deposits. Mr. G. Lane, Aylesbury, and Mr. C. Gandon both introduced the "temperance question" by stating that publicans were the worst payers, and welcomed prepayment meters for their use. Strange to say, eight years later, we find in Lille over 40 per cent. of the automatic meters are fixed at "wine-shops;" so that these engineers' experience appears to have a Continental counterpart. Mr. Price is to be congratulated on his pioneer work. Let us hope he has reaped a rich reward.

The success of the prepayment supply system has been simply marvellous in connection with automatic meters; and it is the aim of the writer to sketch in a cursory manner the history of the growth of the system, and the gradual manner in which gas cookers have become the indispensable auxiliary, and the best-paying portion of the automatic installation.

The position which the penny-in-the-slot supply has now secured may be readily gathered from the statements made, and accounts submitted, at the various meetings of Metropolitan Gas Companies, and throughout the country at the conferences of members of the several Gas Associations. A search through the published records of their proceedings forms most interesting reading; and one at once remarks the rapidity with which public references to the system increase.

1888.

Thus, in 1888, which may be considered the first year of its introduction, we find some half-dozen references, and these include the description of Brownhill's, Price's, and Cowan's prepayment meters.

MR. J. T. LEWIS, WELLINGBOROUGH.

A paper by Mr. J. T. Lewis, of Wellingborough, read at the meeting of the Midland Gas Association in May, 1888, weighs the *pros* and *cons* of the weekly collection plan and the Brownhill prepayment meter. He states: "I have no doubt a great deal could be done to increase this [summer consumption] by introducing small cooking-stoves." Mr. Lewis is doubtless agreeably surprised by now at the extent of the "much" which has been done in following out his enterprising suggestion. At this time the "JOURNAL" devoted an article to "Prepayment for Gas;" and Mr. Lewis's paper was referred to as being particularly opportune. We shall, however, see that it was five years or more before any considerable results followed. Mr. Lewis writes me, under date Sept. 20, 1898:

> We have now abandoned weekly collections (see "JOURNAL," March 1, 1898). The system of fixing cookers with prepayment meters at ——— is giving the greatest satisfaction. Out of 250 consumers, 100 have prepayment meters and cookers. 18s. per meter has been collected for the last three months; and without cookers it would not have been one-third this amount. You are quite right in recommending large-sized cookers. Again, the price of gas should not be much in excess of the ordinary price.

MR. J. M'GILCHRIST, DUMBARTON.

Another important public pronouncement was the very excellent paper read by Mr. J. M'Gilchrist, of Dumbarton, at the meeting of the North British Association of Gas Managers on July 26, 1888, in which, to quote his own words, he referred to the use of oil as "another Richmond in the field," and foretold in truly prophetic style of an "ideal gas company" which would canvass for business on commercial lines, and introduce weekly payments or coin meters to meet the needs of those who could best pay by instalments. The subject-matter of this paper produced a discriminating leading article in the "JOURNAL," which expressed loss of patience with the gas industry for always agreeing that the supply of fittings on hire was desirable, but never seriously adopting this system. It was at this meeting that Messrs. W. & B. Cowan exhibited one of the earliest automatic meters.

1889.

MR. W. A. VALON, RAMSGATE.

The year 1889 advanced the subject but little. The chief interest centred round Ramsgate, with Mr. W. A. Valon's prepayment by collection, as distinguished from the penny-in-the-slot system. The credit of practically removing the barriers raised round those in receipt of a weekly wage, and who might burn gas, by the deposit and quarterly collection, undoubtedly belongs to Mr. Valon; and it must afford him considerable gratification to see the developments of the last ten years, although not exactly on his lines. In a letter to the "JOURNAL," under date Jan. 15, 1889, Mr. Valon makes the first move in suggesting the fitting up of houses complete with fittings at a small and inclusive extra charge on the gas. It is the general adoption of this system—so successful at Ramsgate—that has really made the automatic meters so popular; and Mr. Valon deserves the highest credit for his enterprise, which has profited not only the gas industry, but our

HOUSES FITTED WITH SLOT COOKERS BY THE GASLIGHT AND COKE COMPANY.

NUMBER OF SLOT COOKERS FIXED BY THE COMPANY, ABOUT 80,000.

BETTER-CLASS HOUSES, GLYN ROAD, HOMERTON, LONDON, N.

Rentals average per week	14s. 6d.
Number of cubic feet of gas for 1d.	22
Extra charge per 1000 cubic feet to prepayment consumers	9½d.

CHEAPER-CLASS HOUSES, HOLMBROOK STREET, HOMERTON.

Rentals average per week	10s.

HOUSES SUPPLIED WITH SLOT COOKERS BY THE SOUTH METROPOLITAN GAS COMPANY.

NUMBER OF SLOT COOKERS FIXED BY THE COMPANY, OVER 57,000.

BETTER-CLASS HOUSES, ILDERTON ROAD, BERMONDSEY, S.E.

Rentals average per week*	12s. to 15s.
Number of cubic feet of gas for 1d.	27
Extra charge per 1000 cubic feet to prepayment consumers	9d.

* Some of the larger houses have two f mili s in the house.

CHEAPER-CLASS HOUSES, HYDE STREET, DEPTFORD, S.E.

Rentals average per week	8s. to 10s.

whole working-class population. Indeed, with Buckingham, we agree that—

"The benefit thereof is always granted."

1890. THREE B'S AND LIVERPOOL. In 1890, we find the system still hanging fire, though three B's—the Birmingham, Bolton, and Blackburn Corporations—decide to give the system a trial, and 100 prepayment meters are fixed at Liverpool, where they are most popular, and the demand exceeds the supply; the applications in 1893 coming in at the rate of 100 per week. Then we have the paper read by Mr. J. Lees, on "Maintaining and Increasing the Popularity of Gas," at the Eastern Counties Association, in which he referred to the prepayment consumption as likely, if encouraged, to reach the importance of our third-class railway traffic.

MR. J. LEES.

1891. MR. R. ROSS, DUNGANNON. In 1891, there was but one public reference to the prepayment system, and this not a cordial one, by Mr. R. Ross, of Dungannon, at the North of Ireland Association Meeting at Belfast. He, however, seven years later, referred to the matter again, and approved it most heartily, and, as will be seen in the concluding article, he boldly gives a ½ cubic foot per 100 more to prepayment than to ordinary consumers.

1892. MR. G. I. GOUGH, CALNE. In 1892, there was also one public reference—at the meeting of the South-West of England Association—in a paper read by Mr. G. I. Gough, of Calne, in which reference is made to the excellent methods adopted by the pioneer of the weekly prepayment system, Mr. W. A. Valon, of Ramsgate; but the coin meter is discounted.

1893. MR. G. KEILLOR, NAIRN. In 1893, there were two or three public references, one again north of the Tweed, at the North British Association meeting, by Mr. G. Keillor, of Nairn. This time there was a division of opinion—some commending the system, others "damning with faint praise." This division of opinion is fairly reflected in a leading article in the "JOURNAL" for Aug. 8, 1893, in which the difficulties attending the early pattern meters and various other points, such as "What shall we do with our coppers?" are raised for discussion, and they produced various replies.

MR. F. LIVESEY. One was from Mr. Frank Livesey, who, in a calm, deliberate manner, disposed of the difficulties raised, and nailed the colours of automatic gas-supply to the South Metropolitan mast. "The first South Metropolitan public reference," Mr. G. Livesey writes me, under date Sept. 20, 1898, "was in the report ending June, 1893; and then at the meeting on Aug. 22. We began in 1892 with a boiling-ring, which never approved itself to me; and in 1893 we discarded it in favour of a stove."

MR. F. T. C. LINTON, LEITH. The late Mr. F. T. C. Linton, of Leith, in November, 1893, prepared a report dealing with the question, and pointed out by means of the table given on the opposite page that Glasgow had less than 5 persons to each consumer, and Edinburgh 5½ persons, while Plymouth had 8½; Bristol, 10; London, 14½; and Dublin, as many as 21.

HOUSES FITTED WITH SLOT COOKERS BY THE CRYSTAL PALACE DISTRICT GAS COMPANY.

NUMBER OF SLOT COOKERS FIXED BY THE COMPANY, 6163.

BETTER-CLASS HOUSES, COMO ROAD, FOREST HILL.

Rentals average per week	10s.
Number of cubic feet of gas for 1d.	25
Extra charge per 1000 to prepayment consumers	9d.

MIALL ROAD, LOWER SYDENHAM.

Rentals average per week	8s.
This Company fixed—	
In 1894, cookers with oven	8½ in. sq., 2 boiling burners.
In 1895, increased to	10 in. sq., "
In 1898, further increased to	14 in. by 12 in., 2 boiling burners. 1 grilling and boiling burner.

All Supplied Free.

MR. W. R. HERRING, EDINBURGH. He consequently inferred a smaller demand for the prepayment meter. The real want this system supplies is proved by the fact that, in spite of this, I understand from Mr. W. R. Herring, the present Engineer to the Edinburgh and Leith Gas Commissioners, "that their introduction has been successful, but the consumption averaging 6000 cubic feet is not enough." The remedy is at hand.

Name of Town.	Population.	Number of Consumers.	Number of Persons to Each Consumer.	Gas Sold per Consumer. Cubic Feet.
Greater London	5,700,000	387,982	14·69	83,433
Bristol	225,592	22,585	10·00	56,213
Plymouth	85,610	10,175	8·41	50,613
Birmingham	483,526	57,534	8·40	65 037
Liverpool	513,790	67,300	7·63	42,811
Leicester	180,066	24,369	7·39	39,945
Brighton	116,424	16,583	7·00	49,692
Sheffield	329,585	48,109	6·85	34,340
Newcastle-on-Tyne	192,205	30,000	6·41	49,969
Manchester	511,000	80,571	6·34	36,275
Dublin	349,594	16,000	21·85	64,605
Glasgow	677,883	139,013	4·88	21,218
Edinburgh and Leith	342,000	61,397	5·57	20,071

1894. This year jumps into a prominent position with eleven references, including several valuable papers read at various gatherings of gas engineers, and statements made at The Gaslight and Coke and the South Metropolitan Companies' meetings. Mr. G. I. Gough, of Calne,

MR. G. I. GOUGH, CALNE. again appears before the South-Western Association; and after two more years' experience of the prepayment meter, accords it the highest praise. He fixes a boiling or grilling stove along with the lighting burners. Mr. John West now

MR. JOHN WEST, THE GAS INSTITUTE. raises the question to the level of a place in his Presidential Address to the Incorporated Gas Institute, held at the Westminster Town Hall, on June 18, 1894, and approves it. He reads in full Mr. Valon's 1889 letter, and deservedly gives that gentleman the credit of popularizing the use of gas by first fitting up houses free on a comprehensive basis.

MR. G. LIVESEY. Less than two months after, we have the first of Mr. George Livesey's forcible addresses to his shareholders on the prepayment meter business (the system had been twice previously mentioned, but without special emphasis), in the course of which he refers to the 20,000 consumers already secured, 12,000 using cookers, since increased, on June 30, 1898, to the remarkable total of 72,288 automatic meters, with 56,977 cookers attached—a most gratifying testimony as to the appreciation by the working classes of South-East London of the advantages of gas cooking. It will be noticed that, commencing with this meeting, references to the prepayment system are made by both Mr. Livesey, at all the South Metropolitan Company's meetings, and by Colonel Makins, at those of The Gaslight and Coke Company. I may remark, in passing, that the growth recorded would, if prophesied, have been looked upon as absurd.

MR. HARRY WIMHURST, SLEAFORD. Mr. H. Wimhurst, of Sleaford, at the meeting of the Eastern Counties Association at Yarmouth, in September, 1894, gave his twelve months' experience as satisfactory. Mr. Wimhurst writes me, Sept. 21, 1898: "We have 350 prepayment meters in use, fixed since 1893; many having a cooker at 1s. per quarter; all a boiling burner."

MR. J. T. JOLLIFFE, IPSWICH. The discussion elicited the opinion from Mr. Jolliffe, of Ipswich, that, if cooking-stoves were fixed, they should be large enough to do all the work needed. This opinion, after four years, is now being confirmed on every hand. It is quite a mistake to adopt small cookers. No oven less than 12 inches square is of much practical use; and those 14 inches wide and 12 inches deep are much to be preferred.

The question asked in "Measure for Measure," "*Are not these large enough?*" may now be answered in the affirmative.

MR. G. F. L. FOULGER. Closely following this we have an interview with Mr. G. F. L. Foulger, Chief Distributing Engineer of The Gaslight and Coke Company, on "Slot Meters and Cooking-Stoves." I extract the following: "*We prefer to fix a cooking-stove at the outset, because we depend upon the stove for a great part of the consumption, and because it can be fitted more cheaply at the beginning than afterwards.*" These are weighty words, fully borne out by experience, as one would expect from Mr. Foulger's reputation.

MR. FRANK LIVESEY. Within a few days of this interview came Mr. Frank Livesey's admirable paper read before the Southern District Association on Nov. 8, 1894, from which I make the following important extract: "*The testimony of these [prepayment] consumers is that gas is the cheapest method of cooking.*" Then follows a most practical paragraph—viz., the cost of the installation, which totals up to £5 11s. 9d., including a small cooking-stove. It is most interesting to note that the South Metropolitan Gas Company have from July, 1898, withdrawn this stove in favour of a larger one with three boiling-burners, one of which grills and boils simultaneously, and an oven 14 inches wide and 12 inches deep. The total cost, including everything, will now amount to £6 per house. This remark of Mr. Livesey's should be noted: "*The question has arisen, if a cooker is supplied, whether a weekly rent should be charged. But surely this is not necessary; for, by adding roughly 30 per cent. to the cost, 70 per cent. is added to the revenue. Neither is such a plan satisfactory or convenient to the consumer.*" I respectfully commend these remarks, based as they are on a most extensive and varied experience, to all who charge a cooker rental.

A very interesting discussion followed, in which Mr. A. Dougall (Tunbridge Wells), Mr. George Livesey, Mr. W. H. H. Broadberry (Tottenham), Mr. H. Smythe (Maidstone), Mr. C. E. Botley (Hastings), Mr. F. G. Dexter (Winchester), Mr. J. T. Jolliffe (Ipswich), and Mr. J. W. Helps (Croydon) took part. Here again is to be noted the gradual growth of the references to the

MR. A. DOUGALL AND MR. G. LIVESEY. use of cooking-stoves with prepayment meters. Mr. Dougall was challenged by Mr. George Livesey as to his reason for charging 2s. 6d. per annum rental, when he received 11d. per 1000 cubic feet extra for his gas. Since 1896, the Tunbridge Wells Gas Company have supplied stoves free; and here again the Company are confining their purchases to a larger-sized stove—a 14 inch by 12 inch instead of a 12 inch by 12 inch oven. *A propos* of this discussion, Mr. C. E. Botley writes, Sept. 21, 1898:

"We now make no difference in the rate whether a stove is supplied

or not. Those who have the meter only soon ask for the stove. At the present time we have 1800 prepayment consumers, and are continually increasing. No need to push it; it recommends itself."

MR. J. W. HELPS. Mr. Helps remarked that among their prepayment consumers there were "a great many who wished to be supplied with gas-cookers;" and this seems, even in this early stage, to have also been the experience of the President (Mr. Smythe), who said—and the experience is really valuable—"the average consumption without cookers was 1000 cubic feet per month; but this doubled with the use of a cooker, and came out to about 24,000 cubic feet per annum." He, too, has now (October, 1898) adopted a 14 inch by 12 inch oven and a three boiling burner cooker.

MR. H. SMYTHE, MAIDSTONE.

In the last week of November, 1894, we find the interest in prepayment meters had spread from the charmed circle of the gas industry to that of the Manchester Association of Engineers—a valuable paper on the subject being read by Mr. Nasmyth, in which, as also in the discussion, the merits of the various pattern meters then on the market were candidly canvassed. Mr. Nasmyth appeared inclined to give the palm at this time to Braddock's patent. He, like Iago, is "nothing if not critical."

MR. NASMYTH'S PAPER.

Thus ends 1894—a year which saw the system everywhere debated, and much seed sown, which has borne abundant fruit in the four years following. Great improvements were made in existing patterns of meters, and every month saw fresh patents put upon the market. This year, too, may be considered the one in which the question of fixing cookers with slot meters was fully established—first, by the remarkable business done in them by the South Metropolitan and Brentford Gas Companies, and, secondly, by the decision of The Gaslight and Coke Company to connect a cooking-stove where possible to their slot supplies.

Up to this time there were not many provincial towns which had adopted stoves, and most of them charged a small rental in addition to increasing the price of the gas. The writer's view is that, judging by the conversions to cancelled rentals, and supplying stoves where boiling-rings or grillers had previously existed, we shall speedily see the use of cookers fostered more and more by all enterprising engineers, until the dream of smokeless towns may be within the range of this generation's vision. Then to "Truth's" rhyming question in April, 1898—

> "Will penny-in-the-slot machines
> Supply not teas, but dinners?"

we may answer boldly "Yes."

* * * * * *

The views in this article, and the three following ones, are, where possible, contrasted—the poorest and best in a town being shown; illustrating the wide field to be cultivated between and including these two extremes. The majority of the houses in each view are fitted with cookers.

(To be continued.)

SUDDEN EXTINCTIONS OF ARTIFICIAL LIGHT.

By NORTON H. HUMPHRYS, Assoc.M.Inst.C.E., F.C.S.

The extent to which the public business and pleasure are dependent upon the supply of artificial illuminating agents from central stations, is never more apparent than when, by reason of accident or otherwise, a sudden and unlooked-for stoppage or failure occurs, and the brilliantly lighted places of business or of amusement are instantly in darkness. In the ordinary household, the inconvenience is bad enough, though substitutes are usually not far off. In shops or places of assembly, however, there is not only the temporary annoyance, but also a very real element of loss and personal danger to be reckoned with. It therefore behoves all who are in any way responsible for the distribution of lighting agents, to resort to every possible device that science or skill can suggest as a means of insuring continuity and regularity of supply. As regards electricity, failures are so frequent that the public have come generally to understand that they must not expect too much in the way of reliability from this mysterious form of energy; and an occasional extinction is taken in good humour, as a matter of course, and excites but little comment. But with gas the case is different. The fact that gas is used more generally and to a greater extent, not for lighting alone but also for many other purposes, and that therefore the effects of a sudden extinction are more widely felt, may have some influence; but the public have learnt to expect a greater degree of reliability from gas than from electricity. Any failure in respect to gas supply attracts much more attention, is more fully discussed in the papers, and is regarded as a more important thing, than half-a-dozen similar accidents with the electric current. Only within the last few weeks, a failure of the gas supply at a well-known seaside resort was considered sufficiently important to receive prominent positions in the London daily papers. If electricity had been the delinquent, a bottom paragraph on an inside page would have been the limit of the attention bestowed on it. The fact of a gas failure being such an extraordinary occurrence as to excite so much notice, is a compliment to the reliability of gas supply in general.

That failures teach more than successes, is a common aphorism; but for several reasons it is difficult to get to the real bottom of all the facts connected with a failure. Few delinquents have the necessary moral courage, or if they have, it frequently happens that they cannot afford to come forward and pose before their employers and the public in the position of the "dreadful example" we sometimes hear of in connection with temperance platforms. Anyone with an average knowledge of the ways of the world is aware that a blunder is generally regarded (and requited) as being worse than a crime, and also that there is a general disposition to make a scapegoat of someone or other; and therefore a willingness to come forward and publish the whole of the details for the benefit of the profession at large is not to be expected. But, speaking broadly, there is a noticeable difference in the causes that lead to failure of gas supply, as compared with those concerned in the stoppage of the electric current. The arrangements for the distribution of gas are of an extremely simple character. They commence with the holder itself, and are quite independent of the manufacturing or the purifying apparatus. The gasholder outlet is controlled by a valve; and beyond the valve there is an automatic pressure regulating apparatus. All the mechanical parts involved are plain levers, pulleys, racks, &c., that are not at all likely to get out of order, or to spontaneously stop the supply of gas. But there is always more than one gasholder; and for various reasons the supply must be diverted from one to another perhaps once or twice every day. The drip-boxes also require to be emptied regularly, which is a very simple operation indeed, involving no risk of danger or stoppage. But the human agent is liable to occasional lapses or momentary oversights; and these are the cause of the majority of gas supply failures. One valve is shut off before another is turned on, or the holder is forgotten and allowed to run to ground. The known instances of the failure of gas supply that are due to really unavoidable causes—such as the sudden collapse of a gasholder, valve, or governor—are so few that they could be counted on the fingers of one hand. The arrangements for the supply of electric current are diametrically opposite in character. The generating apparatus is usually a part and parcel of the distributing system, which comprises machinery of such a complicated and delicate character as to call for high appreciation. While the gas engineer relies upon his valvesman to take care of the varying circumstances of the supply, the electrician depends upon his automatic cut-off and other mechanical devices. When a gas explosion occurs, there is usually the satisfaction—such as it is—of ascribing the accident to somebody's recklessness or ignorance; and the same is the case with the failure of the gas supply. With electricity, however, both accidents and failures are of a more unavoidable nature.

One peculiar feature in connection with sudden extinctions may be noticed in passing. Sunday evenings appear to be the most unfortunate period. This is probably due to the special arrangements that are necessary, in order to enable Sabbath rest to be observed at the works to the utmost extent that is possible. But, according to popular report, it happens that hymns and texts appropriate to the unexpected event about to take place have been previously selected. Many preachers go further than this, and adopt the remark they are making at the moment to some sort of harmony with the event. The number of instances of this remarkable circumstance go far beyond the bounds of mere coincidence, and appear to suggest the desirability, in the event of an officiating minister finding that references to "light" are prominent in the various details of the coming service, of sending an advance notice to the gas-works, so that extra care against mishap may be observed. These premonitions do not invariably come true. A few weeks ago it happened that the writer, having fitted up a large church with new Welsbach burners while under repair, attended the reopening service, and references to "light" were made very frequently throughout the proceedings. The new burners, however, kept steadily at work, without even a kick. Probably the real explanation is to be found in the extraordinarily large demand on the part of the public for news items of an extravagantly incredible kind, and also in the fact that the subject of "light" is so very suitable for illustrative purposes in connection with religious subjects that almost every service held would furnish ample matter of this description for the ingenious and imaginative reporter.

In regard to about a dozen instances of failure of gas supply, sufficient to plunge an important part of the district in darkness, the circumstances of which have come to the personal knowledge of the writer, the majority were the result, not of culpable negligence, but of inadvertence. It is easier to make "cock-sure," than to apply a test or examination; but at the same time this common practice is not an indictable offence. The faulty syphon-pump, referred to by Mr. Douglas Hall (*ante*, p. 977), has been responsible for one failure; and the excellent plan of sounding the drips, as advocated by this gentleman, should be adopted. Pumps are apt to fail for more reasons than one; or the man who uses them daily may, in the course of time, get into slip-shod ways. There is the syphon that "never has anything in it," and is therefore left alone, or is tested in an absent and perfunctory manner, and all goes well for years together. But one day the unexpected happens, and the syphon is found to be full of liquid. I prefer to go a step further, and not only gauge the drip-boxes, but also book the results. It is not much trouble,

and the records have at times proved extremely useful; while the mere fact of having to enter the result, and knowing that the entry will be examined, renders the operator more careful. If the drip does not fill at the normal rate, or fills more rapidly than usual, there is something going wrong that should be discovered and promptly remedied.

As to gasholder outlet-valves, a plan similar to the "staff system" used in working single railway lines for traffic in each direction, may be adopted. The "staff" in this case may consist of a small notice board bearing some such inscription as—"This label must always be on an open outlet-valve;" and a standing order is made to the effect that it is not to be touched except for the purpose of moving it to another open outlet-valve. Compound valves of the dry-faced type, so constructed that it is impossible to shut off the supply—one holder coming on while the other is passing off—are serviceable and reliable. A bye-pass direct from the main-inlet to the main-outlet is useful at times of specially large demand, and for temporary employment when the outlet-valves are under repair. This bye-pass may with great advantage be fitted with a safety bye-pass governor, adjusted to come into action at one or two tenths below the pressure given by the highest holder. Two or three holders of adequate capacity are preferable to a battery of smaller ones; but where the latter have to be worked, the inconvenience and risk may be modified by coupling up two or more together, either by loading the lighter one till the pressure of each is equal or by fixing stops on the upper end of the guides of the lighter holder, so adjusted as to prevent it from blowing. The two can then be worked as one holder, of a capacity equal to their combined content. These plans are particularly suitable for small country works, where no special valveman is employed. I remember that the chairman of a small village gas company called on me some years ago, and said that the gas from his works was in the habit of "going out" suddenly in the evenings, perhaps once every three months. As he observed that this was not the usual experience, he thought there must be a remedy. Inquiry elicited the fact that two small gasholders, and a working manager who liked his drop of beer in the evening, were concerned in the difficulty. As one of the holders alone was unequal to the evening's requirements, the other had to be brought into use about 9 o'clock; and it was in connection with this simple operation that a slip occasionally happened. Coupling up the holders, and thus avoiding the necessity for changing or any interference with the valves in the hours of darkness, proved a complete remedy.

Of the few failures due to unavoidable causes, one is worth relating in detail. The drum of the station meter had got out of truth, on account of the wearing of the journals; allowing the axle to bear, and to grind upon the spout. This went on until the metal was rubbed nearly through at that particular place. During the small hours of one morning, a large portion gave way, allowing a sudden rush of water down the inlet. The meter-valve, the main-outlet, and the main-inlet, all drained into one common drip-box; and by this means the water reached the main-outlet, rushed down the outlet of the holder in use—which happened to be the only one on a lower level—sealed the syphon, and stopped the gas. I have described this as a failure; but, as a matter of fact, it was not the cause of the slightest inconvenience in the district, as a safety bye-pass governor formed a part of the distributing plant. When the foreman came on duty at 6 a.m., he found the safety governor in full operation, and the other governors grounded; and the pressure diagrams showed that this took place about 4.30. The only evidence was a diminution of the supply pressure from the usual 16-10ths to 14-10ths. No complaint was received from the district, and nothing at all was known of the accident outside the gas-works.

The foregoing are a few examples of what may be done in the way of guarding against inadvertence or oversight on the part of the foreman in charge; and the safety bye-pass governor will take care of failures due to mechanical causes.

The Laws of the Flow of Water through Pipes and Mains.—M. Georges Dariès, of the Service des Eaux de Paris, has performed a useful work for engineers engaged in water supply by reviewing the formulæ proposed and used in hydraulic calculations. Commencing with the various problems arising out of the flow of water in pipes of uniform and constant diameter, M. Dariès has supplied a small handbook on the general subject to the "Encyclopédie Scientifique des Aide-Memoire." Many of the formulæ relating to the flow of water in pipes are so exceedingly complicated and difficult, that they are never used. There are examples showing a fairly approximate agreement between the results of actual experiment and those derivable from the formulæ of Darcy and Flamaux; and the formulæ recommended by Manning and Unwin have also been attended with considerable success. With good distribution, the velocity should not exceed 2·64 feet per second—especially in districts with sharp gradients—or there will be difficulty in getting the water to flow out of the trunk main into the branches and services. M. Dariès concludes that for towns of fairly good size and population, a supply of 33 gallons per head per day is sufficient for all proper purposes, including road watering, which he reckons to take 3 pints per square yard.

TECHNICAL RECORD.

SOUTHERN DISTRICT ASSOCIATION OF GAS ENGINEERS AND MANAGERS.

The General Meeting of the Association was held last Thursday at the Holborn Restaurant, under the presidency of Mr. R. Beynon, of Torquay. Compared with the meetings of the last year or two, there was a good attendance of members.

The minutes of the previous meeting having been taken as read, the members at once proceeded to the

Election of Office-Bearers.

The President said it was his duty to nominate the President for the ensuing year. He had great pleasure in proposing Mr. A. E. Broadberry, of Tottenham, for this important office. That gentleman was known to all the members. He was an old member of the Association, and had served on the Committee several times; and he (the President) thought he was in every way suitable for the position.

Mr. C. E. Botley (Hastings) had pleasure in seconding the proposition. The matter had, he said, been fully considered by the Committee; and they felt that, in nominating Mr. Broadberry as President, they were recommending a gentleman who was well qualified to carry out the duties of the office.

The proposition was unanimously adopted.

Mr. Broadberry, in thanking the members, said he was deeply sensible of the great honour they had done him in electing him President for the ensuing year; and he felt confidence in accepting the position because he knew they would support him. Otherwise he should have felt some diffidence. He trusted that during his year of office the Association would lose none of its lustre.

Mr. W. D. Child (Romford) said he had the pleasure of proposing that Mr. D. Irving, of Bristol, be elected the first Vice-President of the Association. He was an old member not only of the Southern Association, but also of the South-Western. He had served on the Council of The Gas Institute with Mr. Irving; and he need not say how zealously and earnestly he worked in every way for the good that might be done by these Associations.

Mr. F. F. Farrand (Ryde) seconded the motion, which was heartily agreed to.

On the motion of Mr. W. J. Hicks (Ascot), seconded by Mr. W. B. Randall (Waltham Cross), Messrs. S. Y. Shoubridge and F. W. Cross were elected members of the Committee.

Mr. Charles Gandon said he had been asked to propose the re-election of their Honorary Secretary and Treasurer (Mr. J. W. Helps, of Croydon). He did so with very much pleasure. Those gentlemen who had been members as many years as he (Mr. Gandon) had been would recognize the very great service which had been rendered to the Association by Mr. Helps.

Mr. W. A. Valon (Ramsgate) seconded the proposition. The services of the Honorary Secretary had, he said, been such as to fill the members with gratitude; and he for one was personally glad to find Mr. Helps was going to continue in office.

The President thoroughly agreed with the remarks that had fallen from the two preceding speakers. During the nine months that he had been in office, he had found Mr. Helps a valuable aid, and had seen how much he had the affairs and well-being of the Association at heart.

The proposition was cordially agreed to.

On the motion of Mr. F. W. Cross (Lea Bridge), seconded by Mr. G. W. Anderson (Kenley), Messrs. W. H. H. Broadberry and C. E. Botley were elected to the position of Auditors.

New Members.

The following names were added to the roll of the Association: Mr. C. F. Botley, of Hastings; Mr. J. Dougall, of Margate; Mr. W. Littlewood, of Tiverton; and Mr. J. Young, of Norwich.

The Late Mr. Robert Hunter.

The President said there was one matter which he desired to bring before the members at this stage. They all knew that the gas world had of late suffered a loss by the death of Mr. Robert Hunter, of Chester; and in the last issue of the "Journal of Gas Lighting" it was announced that his family were very badly provided for. The matter had been brought before the Committee; and the result was that he had now to propose that the Association subscribe £5 5s. towards the fund which had been started on behalf of the widow and family of the late Mr. Hunter. They had very deep sympathy with them in their distress; and what the Association were doing as a body need not debar any member subscribing individually to the fund.

Mr. Child seconded the motion, which was unanimously passed.

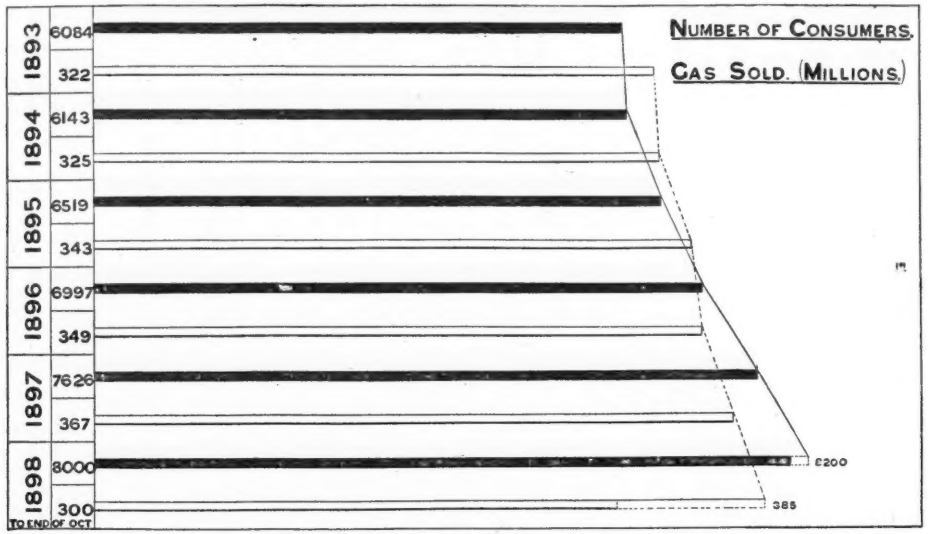
Mr. C. E. Botley (Hastings) then read the following paper, describing

Extended Experience with the Hastings Carburation Process, for the Prevention of Naphthalene Deposits in the Distributing Mains and Services.

At the request of the Committee, I have consented to bring before this meeting, the further and extended experience we have

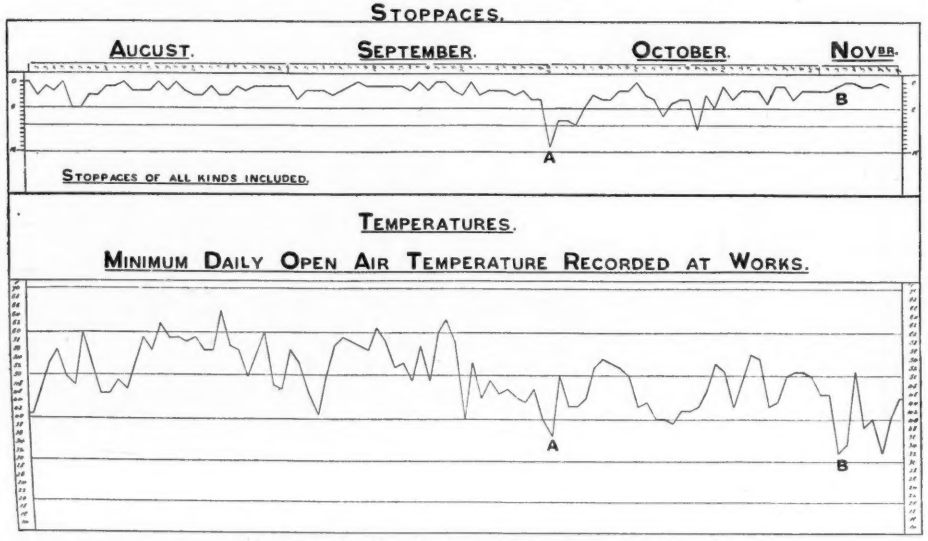
DIAGRAMS REFERRING TO THE CARBURATION PROCESS AT THE HASTINGS GAS-WORKS.

Increased Number of Consumers and Quantity of Gas Sold.



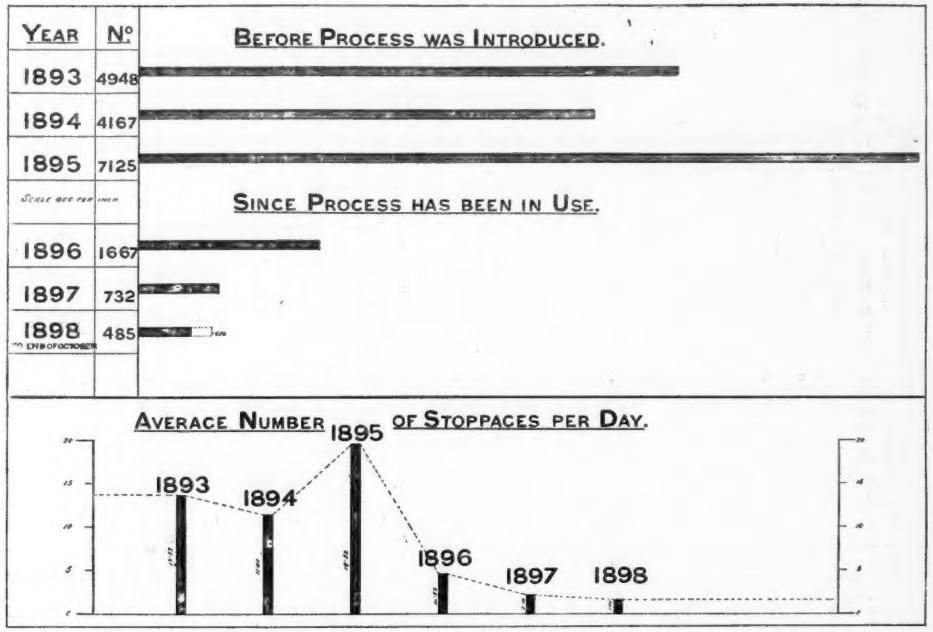
Scales.—Consumers, 500 per ¼ inch; gas sold, 25 millions per ¼ inch.

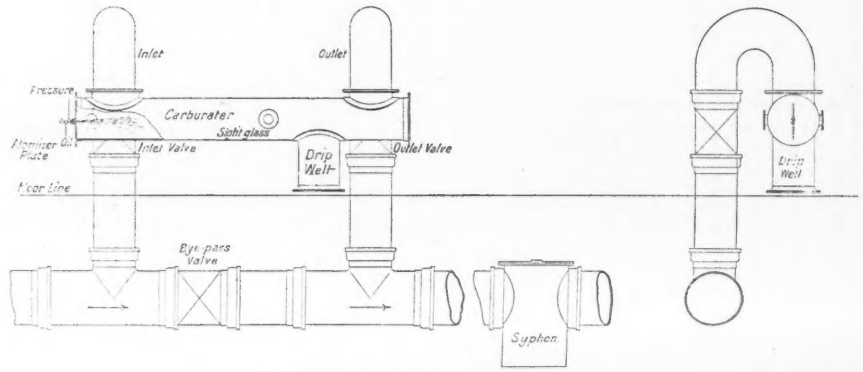
Naphthalene and Temperature Diagram, Aug. 1 to Nov. 9, 1898.



A A. Effect of sudden drop in temperature, process not in use.
B B. " " process in use.

Total Number of Stoppages per Annum.





had at Hastings with the carburation process for the prevention of naphthalene deposits in the mains and service-pipes during the distribution of the gas over the whole canalization.

It will be remembered that a paper on the subject was read before the Institution of Gas Engineers at the May meeting in 1897, when a full account of the naphthalene difficulties at Hastings was presented, and a complete statement given of the various means tried with a view of curing them—all of which had proved failures until this system of carburation had been invented. The effect that this system had had in reducing naphthalene stoppages to an enormous extent, was then described; but criticism was directed to the possibility of the results achieved being fallacious, owing to the time over which the carburation had been employed—viz., sixteen or seventeen months—being considered too short. This contention was not accepted at all by the authors; and the further experience since gained shows their belief to have been well founded.

It may here be well to briefly describe the process, as some present may be unacquainted with it. It is the treatment of the gas going into the district from the outlet of the governors, by adding an oil-mist to it, enveloping the gas in an oily atmosphere, through which it is protected throughout its canalization whence it passes to the burners. This atmosphere, or mist, or fog, is produced by mechanically breaking up a hydrocarbon oil (non-volatile at ordinary temperature) into minute atoms, so finely divided that the mist thus created will float away in the air like smoke from a cigar, and yet have an oily humidity. The production of this oily mist and its application to the gas is accomplished as follows.

A shunt or bye-pass main, with the necessary valves, is fixed on the outlet main from the governor, at one end of which atomizers of special make are placed, and suitable means provided for observing their correct action. A compressing-engine draws gas from the main, and compresses it in a cylinder to a pressure of about 75 lbs. on the square inch. This compressed gas is used for two purposes, at a reduced pressure of 25 lbs. First, to force oil from a cylinder to the atomizers; and, secondly, to supply force at the same point to split the oil up and form the mist. One or more atomizers are used as required, according to the flow of gas. The working is quite automatic otherwise, and can be applied to as many outlet-mains as required with the same compressing plant.

It will now be interesting to record the action of carburation in this manner, as experienced at Hastings. When the system was started, the mains and services were largely charged with naphthalene, which was reduced or increased according to the temperature, but never wholly absent. After the process had been started a month or two, the naphthalene found was much softer, and had an oily appearance. Then, as this gradually disappeared, oil in very minute quantities was found in the governors of the public lamps, which caused a little trouble, but was of very little consequence compared with the naphthalene stoppages. When this had been carried on for a considerable time, the quantity of hydrocarbon oil turned into mist was reduced considerably; and an examination of the mains in various parts of the district showed they were clean, so that, with all vicissitudes of weather and temperature, it was found that 1 gallon of hydrocarbon only was required for every 166,000 cubic feet of gas to keep clear of naphthalene. The cost of this, including all charges, was 0·100d. per 1000 cubic feet of gas sold, or 1d. per ton of coal carbonized. Full particulars and the details will be found in the "JOURNAL OF GAS LIGHTING" of July 26 this year (p. 202), which included the figures to the end of 1897; and the results thus obtained were more than sustained up to the time of stopping the plant for general repairs to the engine, &c., on Aug. 15 of this year. These results I have diagrammatically illustrated.

It is here necessary to mention that carburetted water gas had been introduced, and the proportion added had been gradually increased. Up to the end of 1897, it was only 8 per cent. for the year; but during this year it has been about 20 per cent. The author has contended that carburetted water gas is no remedy for naphthalene directly, though indirectly, of course, it does help; as if you are using 20 per cent. of a gas depositing no naphthalene in distribution, you have that much less to deal with in the total gas. Opportunity was therefore taken of the stoppage of the carburation process to try the effect of distributing the mixed gas as regards naphthalene deposits. The plant had hardly been stopped a week, when one or two small lights were noticed in some duplex-burner public lamps which had originally given trouble, and which had the hole in the plug of the burner-cocks rather smaller than usual. These failures were reported to me as being caused by naphthalene; but the cocks were cleaned and tried again. In a day or two the same thing occurred. One of the cocks was then taken off, and brought in for examination, which proved conclusively that the cause was our old bugbear—this light flaky naphthalene just covering over the gas-way in the cocks.

As we had no complaints from the house services in the district, we let the experiment go on. But we gradually got a few complaints again; and an examination showed that the naphthalene had begun to find its way into the services, while the outdoor foremen concerned begged us to get the carburation plant on again, so as to save the increasing number of complaints. The stopping and re-starting of the apparatus has, however, given opportunity of again following the action of the carburation on the naphthalene; and the observations made confirm this action as originally observed.

Although the apparatus was only stopped for seven or eight weeks, investigation of the mains and services showed that naphthalene had again began to collect; and the first action of the carburation was to apply it in such a manner that the deposits were moistened with the oil-mist and gradually loosened and dispersed, and positive proof was furnished that this naphthalene was to some extent taken along with the gas to the burner and there consumed. The public lamps presenting the least resistance to the flow of the gas, naturally proved this the most. Observation has shown that the amount of condensation found in the street-syphons is, if anything, more in quantity; but it is partly of an oily nature, and of a most pungent smell, which entails the necessity of pumping it into a small tank and bringing it back to the works, where it is disposed of by mixing it with the coal to be carbonized.

It may be interesting to state that it takes about a fortnight in cold weather for the oil-mist to spread through the whole canalization of about 90 miles, when it can be plainly seen on opening a lamp-cock or taking a plug out of the main. It should also be mentioned that a considerable quantity of water is deposited at the point where the gas is first of all treated, which is drawn off from the syphon on the 24-inch separating main. During the whole time that the process has been at work at Hastings, the same description of coal has been in use, and no alteration has been made in the manufacturing plant; the only change made being the gradual increase in the quantity of carburetted water gas mixed with the coal gas. Another matter noticed which is of considerable importance, is that the carburation process protects the gas right up to the dead ends of the mains in all directions, so that the illuminating value is better maintained up to these points. The importance of this is more apparent in a place like Hastings, or other sea-side towns, where there are long lengths of main with dead-ends, than in inland towns where the mains can all be connected up together.

The cost of applying the carburater and necessary apparatus to a 24-inch main would be about £300 or less; and the extra cost for each additional main connected to the same apparatus would be about £100 or less. It is hardly necessary to point out that the cost of the apparatus and of the working is paid for over and over again by the saving effected in the labour in clearing the services, besides avoiding the annoyance to consumers, and the mitigating effect on the using of gas appliances generally, owing to the uncertainty engendered when these stoppages occur.

The theory that has been considered as the most probable one to account for the action of the carburation process in preventing the forming of naphthalene deposits is that an artificial vapour tension is created, and that the naphthalene contained in the gas is mostly taken to the burner and consumed; but that if any should leave the gas, it cannot crystallize—*i.e.*, deposit in a solid form—in the presence of the oil-mist, but simply falls and is carried into the syphons with other condensation. This accords very much with the remarks made in the discussion at the meeting of the Institution of Gas Engineers, when the paper was read.

Calling attention to the diagrams during and after the reading of the paper, the author pointed out that in 1893, before the process was adopted, the number of stoppages per annum was 4948, and in 1895 they had risen to 7125. The first year after the process was in use (1896), the number was reduced to 1667, falling to 732 in 1897, and to 485 in 1898, to the end of October. This point was as low as he could hope to attain to. In 1893, the number of consumers was 6084; and the gas sold was 322 million cubic feet. In 1897, the figures were 7626 consumers and 367 million cubic feet; while up to the end of October this year, they were 8000 and 300 respectively. Although the consumers had increased so very much, the rate of stoppages was reduced to quite a minimum now. Incidentally, this illustrated another point—that was the result of introducing prepayment meters. The diagram indicating the number of consumers and the quantity of gas sold showed that the gas sold corresponded up to a certain point fairly well with the number of consumers. Since they had taken on prepayment consumers, the lines did not so correspond. The consumers had over-lapped the gas sold—showing that, although they had a larger number of consumers, owing to the prepayment meters and incandescent lighting, the quantity of gas had been reduced proportionally very considerably. Directing attention to the naphthalene and temperature diagram, the author said this was perhaps the most interesting. The line in the upper part of the diagram showed the number of stoppages of all kinds since Aug. 1 up to that very morning. It would be seen that, when the apparatus was stopped, the increase in the naphthalene corresponded with the fall in the temperature. When the sudden fall in temperature occurred on Sept. 30, the stoppages at once increased. After the apparatus was at work again, there was, on Nov. 2, a similar drop in temperature; but the line showing the stoppages was maintained practically level—they had no increase whatever. This showed very strongly—in fact, it conclusively proved—as he had contended all along, that the process did prevent the stoppages occurring, under similar conditions of rise and fall of temperature.

Discussion.

Mr. J. W. HELPS (Croydon) said that, as Mr. Botley had mentioned in the early part of the paper, it had been considered by some that, at the time he brought his paper before the Institution of Gas Engineers, a sufficient period had not elapsed to give the process a fair trial. He (Mr. Helps) was perhaps responsible for a remark to this effect at the meeting of the Institution. After a considerable lapse of time, Mr. Botley now presented them with his further experience; and he (Mr. Helps) thought he had practically proved his case—that what he had been doing with this process had, to a very great extent, abolished the naphthalene bugbear. It was naturally very difficult in discussing the paper to speak of it any way but from the naphthalene standpoint; and it would be difficult for those who did speak not to wander a little from the path. It was very evident that at Hastings Mr. Botley must be accomplishing his successful methods in one of three ways: Either he must, in his process of manufacture and purification at the works, be treating his gas in such a way that he did not make naphthalene; or he deposited it on the works; or he must, by his process, be doing something that either prevented the naphthalene falling out, or, if it did fall out, some hydrocarbon dropped out in the liquid form, dissolved the naphthalene, and carried it forward to the syphons. He (the speaker) was not an agnostic; he did not believe in those who stated that they did not believe in anything they did not understand. At the same time, he thought it was the duty of every man who accomplished something to look into that which he accomplished, and try to find out the reason for his faith; and what he had to find fault with in this case was that Mr. Botley had not so far given to gas engineers any very good theory as to the way in which the process produced these results. He told them, in perhaps the most interesting portion of his paper, that they were brought about by creating an artificial vapour tension, which was something he, for one, did not understand; and he hoped that Mr. Browne would have a word to say on this point. Anyone who followed the interesting discussion that took place between Mr. Browne and Mr. William Young would, he thought, have come to the conclusion that it was almost impossible, by the addition of any hydrocarbon to gas, to so alter the average vapour tension as to prevent the deposition of naphthalene. Now Mr. Botley had practically, in his paper, made a comparison between the effects produced on naphthalene by the use of the process and by the use of water gas. In what he (Mr. Helps) was going to say, it might perhaps be considered that he was giving away certain secrets, and he might be looked upon as somewhat of a heretic. In Croydon, they had for the past nine or ten months been using a large proportion of water gas. He might say that, when they commenced supplying water gas, the results were so very pleasing that he thought they had discovered something which would for ever do away with the naphthalene bugbear. Here he would point out that Mr. Botley, in describing the last diagram, stated that he found the number of complaints of stoppage had a distinct ratio to the drop in the temperature. Now, this was not, he (Mr. Helps) must say distinctly, his experience. He found—and he had taken pains to get out figures to prove what he was asserting—that it was not so much the lowest point of temperature experienced during the 24 hours that caused the deposition of naphthalene, as the difference between the highest and the lowest temperatures. He would first refer to the figures for the month of January, when probably the lowest temperature was experienced; at any rate, it was much lower than later on in the year. He found in January, 1897, the difference in the shade temperature throughout a day (he had averaged it over a week) amounted to 7·7°; and during that month they had a weekly average of 32 complaints. In the same month this year, they had an average difference in the temperature of 10·6°; and they had a weekly average of 45 complaints. Then he passed on from January (which might be taken as a fairly typical month) to July. In that month, they had an average difference in temperature of 22·6°; and the average weekly complaints rose to 194. The same month this year, the average difference of temperature was 22·3°; and the number of complaints had averaged 201 weekly. These corresponded fairly well when the increased number of consumers was taken into account. In August, 1897, the average difference was 19·3°, with a weekly average of 145 complaints. This year in August 21·2° represented the difference in temperature; and they had 189 complaints. In September this year, as they all knew, the difference of temperature was very great. He was not only talking of shade temperature, but the sun temperature was so high that the gas in the holders was heated enormously, but was no doubt quickly cooled again when it reached the mains. The difference in temperature in September, 1897, was 15°, with a weekly average of 96 complaints. In the same month this year, the difference of temperature was 22·4°, and a weekly average of 235 complaints. That was a sad state of affairs to speak of as happening in connection with what he looked upon as a fairly well-managed Company. (Laughter.) He knew it was more by their failures than by their successes that they hoped to learn and arrive at the goal they were all striving for. He believed, when the members came to look at these figures, they would find that the number of complaints bore a ratio to the difference between the average highest and the lowest temperatures during a week or day as the case might be. As to water gas, at Croydon they put 25 to 30 per cent. into a cylinder which was common to the inlets of the holders. He took it in the light of what appeared in the discussion between Mr. Browne and Mr. Young that the coal gas as it entered the holders was, at a temperature at which it then existed, practically saturated with naphthalene. The addition of 25 to 30 per cent. of water gas practically formed a compound, which in itself—water gas having no naphthalene—was in an unsaturated condition; and in that condition the mixed gas passed on to the holder. In very hot weather (being heated up in the holder to a considerable extent), as it left the holder, it came into contact with previous depositions of naphthalene, and undoubtedly it picked up a large quantity. And so at this high temperature (he might say above 100°), it issued in an unsaturated condition; and in this state it went out into the town. What happened? Was it possible to cool steam below a certain temperature without reducing it to water? Was it possible to cool gas saturated with naphthalene without the naphthalene dropping out in some form or another? He said "No" distinctly. They might have the day temperature very high and the night temperature low; and it seemed to him impossible to prevent, by the use of water gas, the deposition of naphthalene. If they were to put the water gas on the outlet of the holder, they would make the mixing a much more difficult matter; and then it was quite possible they would send out a gas in an unsaturated condition, which would pick up any naphthalene already deposited. In winter, when the holders contained gas in a cooler condition than it might be in the mains, it was quite possible then for an absolutely opposite effect to be produced. The gas itself came out cool, and became heated in the town; and consequently, by the heating, it was raised to a condition in which it was unsaturated. He thought one remark might prove this. During the hot weather when the gas was tested at the works, they would find that the illuminating power was (say) 15¾ candles; and if it was tested 2 miles from the works, it would be found to be 15½ candles. In cold weather, when the gas in the holder was cooler than in the mains, they would find the opposite; it might be only 15¼ candles at the works and 15¾ candles a distance away. He thought this was a fairly distinct proof that there was something in what he was asserting; and he could not help thinking that Mr. Botley even now had not got to the true reason for the results he had obtained. If he (Mr. Helps) might be allowed, he would suggest one little point. Mr. Young, in his arguments with Mr. Browne, practically stated that the deposition of aqueous vapour from the gas really had nothing to do with the deposition of naphthalene in the mains. It was possible perhaps that, from the chemical point of view, it might have nothing to do with it; but, from a mechanical point of view, it had, in his (Mr. Helps's) opinion, a great deal to do with it. He believed Mr. Botley had said that in his process he found, almost immediately after the mixing cylinder, a considerable deposition of aqueous vapour. Was it not quite possible that at the exact moment that this aqueous vapour was thrown down that this fine mist or fog took the place previously occupied by the water vapour. The result was that this oil vapour would not be thrown down by the cooling of the gas afterwards in the mains, and the mechanical effect caused by the deposition of what would be otherwise aqueous vapour was prevented from acting on the gas so as to produce the naphthalene deposits. He thought that those who had suffered (as gas engineers had done in London during the past summer) from an immense number of naphthalene complaints would adopt this process if Mr. Botley would prove to them that he had (as he bid fair to prove) found out a means by which they would be saved further difficulty.

Mr. A. F. BROWNE (Rotherhithe), called upon by the President, said that unfortunately he arrived when the paper had been partially read; and it placed him at some disadvantage. He did not feel he had much to say on the subject of naphthalene when he entered the room. He thought he gave some of them an overdose of it a few years ago, even if he did not take one himself. Mr. Helps's remarks had practically covered the whole ground; but the more he (Mr. Browne) heard of the process of Mr. Botley's, the more it appeared to him that he had proved his case. Theory was one thing; practice another. Mr. Helps had rather fallen foul of Mr. Botley, because he had not been able to produce a theory which was satisfactory to everybody. He thought perhaps Mr. Botley would say he had not produced a theory that was satisfactory to himself. That was probably a very difficult thing to do; and he did not think they ought to quarrel with a process because they did not know how it was done. They were, of course, anxious to know, and would be glad if some day the whole method was made clear to their understanding. He thought, however, that all Mr. Helps had contributed to the discussion with regard to the probable causes of these effects was very interesting, and very likely it might be true. As to Mr. Botley's statement that, at the point where the oil was atomized into the gas, there was constantly found a considerable deposit of water, that struck him (Mr. Browne) as a notable fact. Mr. Helps had, he thought, followed that up all right, and had drawn from it the same conclusion that he (Mr. Browne) would have been disposed to have drawn from it—that, in some way or other, a gas which was carrying one liquid in a very finely divided form was unable to carry two at the same time. It dropped one to take up the oil mist, and the oil mist

acted probably mechanically, and, being in a very fine state of division, had an extraordinary vitality (so to speak) in its travel in the gas. He believed he understood Mr. Botley to say that he found the light vapour still maintaining itself in the gas even at the remotest ends of his mains. That being so, they must admit that the light vapour had an astonishing vitality; and it seemed to him, failing a better theory (and he thought he was practically saying what Mr. Helps had already said), that, in some way or other, this light oil carried the naphthalene. He also agreed with what Mr. Helps had said as to the result of the correspondence he had a few years ago with that great authority on this matter (Mr. Young). It did appear to him that in some way or other this light oil mist was able mechanically to carry these small particles of naphthalene—partially, he supposed, they were dissolved. They would naturally suppose that, if the minute drops of oil dissolved up naphthalene, they would fall; some would fall, and some would survive. The process, however, had most certainly delivered Hastings from the naphthalene nuisance. Mr. Botley had applied the best experience to the other side of the question. For a certain period, he told them, in order to put the matter to the test, he discontinued the process of atomizing the oil into the gas, and then the complaints began to increase in number. That being so, they need hardly be surprised that Mr. Botley cut the experiment short; but perhaps he would try it again at another time. He did not think they ought to grudge Mr. Botley their admiration and approbation of his scheme. It was perfectly true that it might be that he did not now produce the naphthalene at his works, even if he produced it before. They could not settle that question; it was impossible. He, however, believed the success of the process was established; and he could heartily congratulate Mr. Botley upon that success. He was not surprised that he had been unable to find a theory that would put the method of its working beyond a doubt. Like Mr. Helps, he (Mr. Browne) did not quite understand what was meant by an artificial vapour tension being created. He had not studied naphthalene much lately, though he had had more than usual on his works.

Mr. A. E. Broadberry (Tottenham) remarked that, when he first saw the process at Hastings, he was struck with the fact that there was a large quantity of water deposited in the syphon; and it had occurred to him that this did justify Mr. Botley in making the claim he did for his apparatus. With regard to carburetted water gas, Mr. Helps had dealt with that pretty fully. At Tottenham, they had certainly found more advantage from carburetted water gas than either Mr. Helps or Mr. Botley had done.

Mr. Helps: You use more of it.

Mr. Broadberry said that probably it was due to the fact that these gentlemen sent out the carburetted water gas in the proportion of 1 to 3; while at Tottenham they sent it out in the proportion of 1 to 1. There was one other point in the paper which neither Mr. Helps nor Mr. Browne had mentioned. He saw that Mr. Botley dealt with the gas at the outlets of the governors. It would be interesting if he would tell them whether he had come to the conclusion that it was not applicable on the inlet of the governor. The pressure at which the oil was injected—75 lbs. on the square inch—was so high that surely it could not make any difference, with two or three inches variation in the pressure of the gas, whether it was on the inlet or outlet of the governor. He should like Mr. Botley to inform them the reason for the treatment being applied at the governor outlet.

Mr. C. F. Botley (Hastings) said, in making a few remarks, he would endeavour somewhat to relieve his chief by replying to some of the remarks already made. First of all he should like to make clear the point raised by the last speaker. The only object in putting the apparatus on the outlet of the governor was this: That excessive friction meant an excessive deposition of oil from the gas when it was supersaturated. At certain hours of the day the consumption of gas varied wonderfully. At one hour at Hastings, it might be as high as 240,000 cubic feet; while at another it might be down to 15,000 or 20,000 cubic feet; and they did not want to be "fiddling" about with the atomizers all the time; and so they simply set the apparatus and allowed it to go on. The consequence was they got supersaturated gas, and this they partly recovered with the water in the syphons on the main. They always got a certain amount of water in the syphons; and they afterwards separated the oil from that water. Up to a certain specific gravity the oil was used over again. This he thought would answer what Mr. Broadberry had said. It had nothing whatever to do with pressure, though it was better to work with the town pressure than the holder pressure; and the process could be applied anywhere they liked. Now looking at the paper which was read before the Institution of Gas Engineers, it would be found stated there that carburated gas would not carry water, which was possibly a powerful clue to the action on naphthalene. The words in the paper were: "Carburated gas is permanent under ordinary conditions, and will pass through water without alteration. This is probably a clue to its powerful effect on naphthalene, in the formation of which moisture is an important agent." He was perfectly well aware that this had been much questioned by an authority with whom he would not wish to class himself; but at the same time, from his (Mr. Botley's) experience, he believed it to be true. "Carburated gas will not apparently carry water any more than oil-sheets will absorb water." That was what was written in the Institution paper; and it showed that the point as far as water was concerned had been dealt with. Now he came to the question of the highest and lowest temperature; and he thought Mr. Helps must have rather misunderstood the paper. The point in the diagram which showed a sudden rise in the number of stoppages had been referred to as being the actual result of a drop in temperature; and he believed Mr. Helps would find in that case that it was quite independent of the difference in the mean temperature or cold. It would be seen that the apparatus was off in one case of a sudden drop in temperature, and on in another; and the diagram was really got out to show that, when the apparatus was in operation, fluctuation in temperature did not affect the results. When it was not in use, the effect was seen on the diagram. As regarded naphthalene on the works, he need scarcely assure Mr. Browne that there was no difference in this respect. They produced naphthalene on the works practically the same as they had always done. But they knew perfectly well that, if they did not use the apparatus, or if they did not use it efficiently, they got naphthalene all over the town. This was to his mind sufficient proof of its utility. With other things to do, he could not go looking about for a theory when he was relieved of all difficulty by simply keeping this simple apparatus at work. If Mr. Helps would only give him the opportunity, he should be pleased to show what could be done with the apparatus at Croydon.

Mr. S. W. Durkin (Southampton), in response to a call from the President, said he was not in a position to discuss Mr. Botley's paper; but on the general question of naphthalene, he might say it was a difficulty he had not yet been able to overcome. If Mr. Botley's system was so successful at Hastings, he did not see why it should not be tried elsewhere, so as to ascertain if it would get rid of the horrible naphthalene nuisance under varied conditions. He had noticed that, in certain parts of his district, there was a deposition of naphthalene in the mains, which appeared to him to rise after the gas had deposited a certain amount of moisture; but in mains going out 5 or 6 miles from the works, they got very little as a rule, so that apparently a drying process went on which prevented the deposition of naphthalene. If this process tended to hold the naphthalene in suspension and carry it on, so much the better for the illuminating power of the gas. He hoped that some other engineer would take up this process, and try it in a different district to Hastings. He might add that, when the temperature varied very rapidly after a warm day, then he found that the naphthalene trouble came on very quickly. It had been so more or less all the summer, because they had had some very wintry nights; and he attributed the difficulty to decrease in the temperature bringing on the deposition, especially in the public lamps.

Mr. P. Thomas (Wellington) said managers of small works could scarcely hope that their Directors would spend £400 or £500 on an apparatus of this kind, in order to deliver their managers from the naphthalene difficulty. Stoppages of service-pipes had been his trouble for years, especially in cold winters. He did not have much trouble last winter; but there had been times when he had had 43 lamps stopped out of 140. The best remedy he had found for dealing with the stoppages both in public lamps and consumers' services was simply to remove the tap and pour in ½ gill of naphtha. They were much indebted to Mr. Botley for his paper; and the only question he had to ask him was as to the class of coal he used.

Mr. W. H. H. Broadberry (Tottenham), having congratulated Mr. Botley on the progress he had made with his invention, said this question of naphthalene had always been a bugbear; but he hoped it would not always be so. For the last 45 years, he had been troubled more or less with it in one shape or another. At one time, gas engineers were satisfied if they made something like 8500 cubic feet of gas per ton of coal. Then they did not know what naphthalene was. By-and-bye, however, they had to make 9000 cubic feet per ton, then 9500, 10,000, 10,500, and so on, with the result that they had naphthalene in all directions. He understood Mr. Botley to say that he used petroleum. They all knew that for years past naphtha had been spoken of as a remedy for stoppages. He remembered a paper being read before one of the societies in which the author recommended the sprinkling of each tier of the purifiers with naphtha. He (Mr. Broadberry) was silly enough to try it. For the first few days after starting the purifiers, they did not have much naphthalene; but afterwards they had as much trouble as ever. He agreed with Mr. Helps that the deposition of naphthalene in the mains had more to do with the variation of temperature from day to night than anything else. Before they adopted the water-gas process at Tottenham they were troubled with just as much naphthalene as anybody ought to be. But on water gas being used, the naphthalene began to clear away; and practically they had had no trouble since. A short time ago, they were troubled with a deposition in the pipes that looked very much like naphthalene; and they thought it was. They had formerly been using Russian oil, but had got away to the American oil. With the latter oil they had been working at the same heats as with the Russian oil; and they found that it would not do. The trouble they had was not naphthalene; and, on altering the heats in the saturator, they found that the difficulty ceased. They had lately been re-laying 40 or 50 feet of 2-inch pipe with 4-inch; and in the 2-inch pipe they had

had frequent stoppages. They had always given naphthalene the credit for this; and so, when they took up the pipe, they carefully disconnected it, with the result that they found some very fine iron rust had collected in it. Since the 4-inch pipe had been down, they had not had any trouble. He was very pleased with Mr. Botley's apparatus; and he hoped that, by the next time the author read a paper on the subject, he would have made a perfect apparatus of it, if was not already so to be regarded.

The PRESIDENT said he did not think he could amplify any of the remarks that had been made; the ground seemed to have been covered most thoroughly. There was one question he should like to ask, and that was as to the state of the naphthalene question at Hastings before Mr. Botley put his process in—whether he got naphthalene in all districts alike; or whether he suffered from it in some places and not in others. At Torquay, they had houses from which they had never had a complaint ever since he had been there, no matter what the temperature might be; while the adjoining houses were continually suffering, and the Gas Company's man had to blow out the pipes perhaps once a week. Mr. Botley deserved a great deal of credit for having produced this process. He (the President) had been down to Hastings, and seen it at work; and it seemed to have met with great success there in doing away with complaints. The question had exercised him as to whether he should adopt it at Torquay to get rid of the naphthalene nuisance there.

Mr. BOTLEY, in reply, said he was very pleased with the tone the discussion had taken. Mr. Helps, who described himself as his great antagonist, but he (Mr. Botley) did not look upon him as such, had raised a number of questions; but to some extent he had been treading on ground which was covered in the paper read before the Institution of Gas Engineers. The same arguments that he had now used were considered at that time. He (Mr. Botley) was told that he advanced no theory as to what occurred in this process. Mr. Browne had to some extent answered that for him. It was most difficult to raise a theory in a matter of this kind. The question had given him a great deal of thought and consideration. His son and himself had discussed it, and had tried to discover what really took place; and to the best of their belief that which did occur was what was stated in the paper. With regard to the remarks which had been made as to the term "artificial vapour tension," there was a possibility, he thought, of the vapour tension being artificially increased. A question had been put as to whether there was any alteration in the naphthalene on the works. They had never had much trouble on the works with naphthalene. It had not increased; it was exactly the same. They did get naphthalene on the works, and had to clear out the apparatus periodically; but they had no particular trouble, as they looked after it in time. Mr. Browne's suggestion that they did not produce naphthalene was covered by that statement. They used the same description of coal now, worked at the same heats, and practically sold the same quantity of gas per ton of coal carbonized as formerly. For the last thirty years, they had used New Pelton and Pelaw Main coals. These coals in working did produce naphthalene; but they were good coals in all other respects.

Mr. BROWNE remarked that he did not suggest that Mr. Botley did not produce naphthalene on his works.

Mr. BOTLEY said he understood Mr. Browne to say that there was the possibility that at the present time they were not producing naphthalene. In regard to Mr. Durkin's remarks, if the gas had a long way to travel in the pipes, and naphthalene had been deposited for some distance, of course at the extreme ends they would find none. One point which he hoped was noticed in the paper was this: That, by enveloping the gas with an oil mist, they carried the illuminating value of the gas right to the end of the district. There was no question about that—in fact, the improvement in the light at the far ends of their area had been commented upon. In the days before the adoption of the process, the gas had been very thin sometimes at the extreme ends; but now it looked as good there as it did close to the works. Mr. Thomas had raised a question about the cost of an apparatus of this kind. He had given the cost of applying the process to a 24-inch main; but if it was only for a 6-inch main a very simple thing would accomplish the same purpose. He might mention that, although they had naturally protected themselves in regard to this process, the patent had not been taken out with the view of making a lot of money. He could not say anything fairer than this: That he would give anyone present permission to try the process by arrangement with him, and see for themselves what the results were. Mr. Broadberry had spoken of the formation of naphthalene being largely owing to increased heats. This was no doubt the case. Now they had to get all they could out of the coal, which they would not do if they worked at the old temperature. With regard to the oil employed in the process, they used the ordinary tea-rose oil of commerce, which could be bought at 6d. per gallon. The President asked whether he had had districts in which there was no naphthalene before the process was started. He could answer that in the negative. His experience was like that of the President, that the action of naphthalene was most erratic. As to particular houses suffering more from naphthalene than others, from what he had been able to gather, he had come to the conclusion that it was merely due to the extra facility afforded by one pipe over another for naphthalene passing in. He was satisfied that what had been accomplished at Hastings anybody could do by the same means.

Mr. W. B. RANDALL (Waltham Cross) read the following paper on—

LOCALIZING LEAKAGES.

The subject of localizing leakages will occur to most gas engineers in the routine of business, being so closely allied to that "Will o' th' wisp" unaccounted-for gas, which so largely determines the success of gas undertakings. Dividends are truly said to be made or lost in the retort-house; but according to the annual Parliamentary Returns, it must be conceded that in many cases good manufacturing results are marred by a weak distribution system, and the dividend thereby lessened.

I do not propose to quote statistics on the amount of leakage, &c., as they are already well known, but simply to submit a method of localizing leakages which I have found to be both economical and satisfactory. The usual plan pursued in testing distributing mains, services, &c., is to take a length of main, &c., drill holes, and insert bladders at both ends; then connect up with a testing-meter, and note the amount passing through the meter to supply the main under observation. One bladder at each end is not reliable, as they are apt to pass a certain amount of gas and spoil the value of the test. The safer method is to have two bladders close together, filling the space between them with water from a short stand-pipe; or to cut out and plug off the main at each end, having first shut off all main, lantern cocks, &c., on the particular length under observation. Another method is to have syphons which, by means of a diaphragm or midfeather, reach within a few inches of the bottom of the box, which can be sealed by water, and so ensure gas only passing by the midfeather through the arranged connections and meter.

The principal objection to these methods is that they are liable to cause a certain amount of inconvenience to consumers, through having to shut off their main tap during the tests. Also that in bladdering and meter connections considerable time and labour are expended, and the main weakened by the necessary holes. Again, the main taps and lantern cocks may bye-pass or leak; and after ascertaining the exact amount of leakage, the actual source remains to be discovered.

These objections do not exist in the following system, which depends upon using a leakage indicator. This consists of a porous diaphragm, through which any mixture of gas and air can percolate, and which is so arranged that the percentage volumes are indicated by a pointer on a graduated dial. The instrument operates through the well-known law of diffusion of gases—viz., the velocity of diffusion of gases is inversely proportional to the square roots of their densities. Thus four volumes of hydrogen will pass through the diaphragm in the same time as one volume of oxygen is able to do, oxygen being sixteen times as heavy as hydrogen.

In the case of a district where plans, notes, or records are not obtainable as to the size and position of the gas-mains, Ordnance maps are procured and copies of the thoroughfares are transferred on an enlarged scale to a suitably ruled note-book. All new mains when laid are duly noted as to their sizes, position, &c., and a plan and section of the ground showing the main is made as required. The service layers also note the depth and position of the main whenever they excavate to lay or repair a service; and as other opportunities occur—such as excavations to sewers or water-pipes—notes are made of the same and recorded.

The method of procedure must, of course, be governed by the locality; but, as an instance, let us presume that we start from the outlet of one of the district governors, and that for 100 yards the main is laid in a straight line under a macadamized road, and has about 2 feet cover. Having ascertained the exact position of the main, a searching rod is driven down on alternate sides of the main at each end. The space between is marked off into distances of about 3 yards each; then another rod is driven down near the side of the main, so that as nearly as possible the search-holes run diagonally, and in the trench originally excavated for the main when laid. It is hardly necessary to add that discretion must be used so that the rod does not cause damage to any water, sewer, or drain pipes, or the gas-main itself. Having driven a rod down to about the level of the underside of the main, a little sand is placed round the top of the hole, to secure an even surface. The rod is then withdrawn, and the indicator immediately placed over the search-hole. If the pointer on the indicator remains at zero, it may safely be assumed that the main within some yards of that spot is sound. The search-hole is then filled in, the bar driven down at the next point, and so on; the testing being continued until the pointer moves and indicates a leakage. Then the value of the instrument is apparent, because you can drive down rods and note the readings until the maximum is indicated, when on excavating at that spot the actual leakage will be discovered. After a little experience, the operator becomes remarkably accurate in successfully localizing the leakage. Where the mains are laid under the footpaths, which may be paved with Victoria stone, Granolithic or York stone, the rod is driven down in the angle of the nearest joint. Tar or asphalte paving offers no such chances; but the hole made by the rod

Year and Quarter.	Half Year.	Year.	Gas Made.	Gas Sold.	Used on Works.	Leakage.		Gas Made Per Ton.	Gas Sold Per Ton.	Miles of Main.	Number of Consumers.
			Cub. Ft.	Cub. Ft.		Cub. Ft.	Per Ct.	Cub. Ft.	Cub. Ft.		
1892.											
Michaelmas	..	..	4,498,800	3,253,500	..	1,245,300	27·03	10,684	7,727	..	..
Christmas	..	..	8,846,400	7,890,900	..	955,500	10·79	10,645	9,495	..	..
	Dec. 31	..	13,345,200	11,144,400	..	2,200,800	16·48	10,671	8,901	15	500 (250 P.L.)
1893.											
Lady-day	..	..	7,714 500	6,910,100	..	804,400	10·42	10,570	9,469	..	..
Midsummer	..	..	4,319,800	3,469,700	..	850,100	19·67	10,664	8,567	..	..
	June 30	..	12,034,300	10,379 800	..	1,654,50)	13·75	11,094	9,569	..	..
Michaelmas	..	..	4,805,800	3,789,900	47,000	968,900	20·01	10,562	8,329	..	..
Christmas	..	..	9,022,500	8,348,000	93,000	581,500	6·44	10,334	9,562	..	..
	Dec. 31	..	13,828,300	12,137,900	140,000	1,550,400	11·20	10,414	9,140	..	..
		Dec. 31	25,862,600	22,517,700	140,000	3,204,900	12·38	10,718	9,332	15	539 (247 P.L.)
1894.											
Lady-day	..	..	7,934,700	7,170,100	86,000	678,600	8·54	10,254	9,263	..	..
Midsummer	..	..	4,849,200	3 778,900	42,000	1,028,300	21·20	10,252	7,989	..	..
	June 30	..	12,783,900	10,949,000	128,000	1,706,900	13·36	10,662	9,131	..	..
Michaelmas	..	..	5,796,000	4,907,800	52,000	836,200	14·42	10,465	8,861	..	..
Christmas	..	..	9,992,300	9,285,400	106,000	600,900	6·01	10,527	9,782	..	..
	Dec. 31	..	15,788,300	14,193,200	158,000	1,437,100	9·11	10,504	9,443	..	..
		Dec. 31	28,572,200	25,142,200	286,000	3,144,000	11·00	10,574	9,305	18	762 (271 P.L.)
1895.											
Lady-day	..	..	9,144,000	8,369,700	97,000	677,300	7·40	10,228	9,362	..	..
Midsummer	..	..	5,374,500	4,423,800	48,000	902,700	16·80	10,527	8,589	..	..
	June 30	..	14,518,500	12,793,500	145,000	1,580,000	10·88	10,924	9,735	..	..
Michaelmas	..	..	6,036,000	4,977,700	111,000	947,000	15·68	11,095	9,187	..	..
Christmas	..	..	10,656,000	10,210,500	223,000	223,000	2·09	10,602	10,258	..	..
	Dec. 31	..	16,692,000	15,188,200	334,000	1,170,000	6·41	10,774	9,869	..	..
		Dec. 31	31,210,500	27,981,700	479,000	2,750,000	8·81	10,840	9,719	21	880 (293 P.L.)
1896.											
Lady-day	..	..	8,998,000	8,800,900	97,000	100,100	1·11	10,561	10,388	..	..
Midsummer	..	..	5,539,000	4,829,200	48,000	661,800	11·95	10,431	9,094	..	..
	June 30	..	14,537,000	13,630,100	145,000	761,900	5·25	10,511	9,855	..	..
Michaelmas	..	..	5,994,000	5,577,700	83,000	333,300	5·55	10,608	9,872	..	..
Christmas	..	..	11,028,000	10,399,300	167,000	461,700	4·19	10,335	9,746	..	..
	Dec. 31	..	17,022,000	15,977,000	250,000	795,000	4·67	10,430	9,790	..	..
		Dec. 31	31,559,000	29,607,100	395,000	1,556,900	4·93	10,467	9,820	23	865 (299 P.L.)
1897.											
Lady-day	..	..	10,253,000	9,565,600	200,000	487,400	4·75	10,486	9,783	..	..
Midsummer	..	..	6,201,000	5,636,500	100,000	464,600	7·49	11,152	10,137	..	..
	June 30	..	16,454,000	15,202,100	300,000	952,000	5·79	10,726	9,910	..	..
Michaelmas	..	..	7,141,000	6,531,800	133,000	476,200	6·66	11,037	10,095	..	..
Christmas	..	..	12,949,000	11,387,500	267,000	1,020,500	7·87	10,701	9,411	..	..
	Dec. 31	..	20,090,000	17,919,300	400,000	1,496,700	7·46	10,819	9,649	..	..
		Dec. 31	36,544,000	33,121,400	700,000	2,448,700	6·69	10,776	9,767	25	910 (311 P.L.)
				In store +	274,000		*				
1898.											
+In store, Dec.	31, 1897	..	274,000								
Lady-day	..	..	10,861,000	10,256,700	200,000	600,300	5·39	10,807	10,283	..	..
			11,135,000	In store +	78,000						
	..										
+In store, Mar.	31, 1898	..	78,000								
Midsummer	..	..	6,381,000	6,113,200	100,000	182,800	2·83	10,706	10,256	..	..
			6,459,000	In store +	63,000						
	June 30	..	17,242,000	16,369,900	300,000	783,100	4·46	10,769	10,225	25	940 (312 P.L.)
+In store, Dec.	31, 1897	..	274,000								
			17,516,000	In store +	63,000						

* Increase partly explained by inflation of new gasholder and laying 1½ miles of 12-inch main.

is only ¾ inch diameter, so that it is easily and immediately repaired to avoid any possible complaint.

The instrument is extremely sensitive; and the pointer will indicate very minute leakages. As an evidence of this, I may mention that in some cases when the leakage was exposed it was so small that it would not burn continuously; and in other instances, when the conditions admitted a light was applied on drawing out the bar, and it would not show the small blue flame so often found in main and service leakages. Some of the curiosities unearthed through the use of the indicator are submitted for your inspection, as well as one of the search-rods and an indicator.

It is very remarkable how some soils have the power of deodorizing the gas, so that in the case of broken mains in frequented places no idea of their condition was entertained until discovered through using the indicator. Also in some instances leakage had occurred to the mains and services through persons having seriously damaged them, and, instead of notifying the fact to the gas company, had driven in rough wooden plugs, and bound up other places with sacking and white lead and various other subterfuges, to cover up the damage. One of these cases was caused by an irresponsible agent which is among the curiosities—viz., a root of ivy. This had run under a 2-inch cast-iron main, moulding itself as it grew to the shape of the pipe, and when it gained sufficient strength causing a fracture in the main. But as punishment should always fit the crime, the escaping gas retaliated and killed the ivy.

The question will naturally arise as to whether the saving effected justifies the outlay incurred; and it may be taken for granted that where the unaccounted-for gas equals about 8 per cent., the expenditure on some such system is well warranted.

The actual cost of (say) two of the indicators and six searching-rods will not exceed £4; and if the exact position of the mains is known, the actual time in testing is reduced to a minimum, as compared with any plan of metering the leakage and stripping the mains.

Many remarkable instances of difficulties caused through the elusive nature of gas leakages will have occurred to all the members; and I venture to hope that the system which I have had the pleasure to bring before your notice may save some of the trouble and expense in localizing leakages.

The figures given on p. 1099 will probably prove interesting as an instance of reduction of leakage. In submitting them, please allow me to state that they are not advanced to claim the total reduction being caused directly through the leakage indicators, because we have relaid some mains and services. Neither do I wish to make any claim to have originated this particular system, or to have reached the irreducible minimum, as regards leakage. But if I have succeeded in laying before you a method which may prove of some service to the members, and help the gas industry to strengthen a weak point, I shall feel well repaid for the time given to the writing of this paper.

Discussion.

Mr. J. L. CHAPMAN (Harrow) said that, having been connected with Mr. Randall for some years, he should like to say a few words to open the discussion. With reference to the general question of unaccounted-for gas, he was sorry to say that at Harrow they had been progressing backwards—they had gone from a very small leakage to a large one. The only way he could account for this was that he had had a new district added on to his old one. During the time Mr. Randall was with him, they had a leakage of 4 per cent. year after year; but this had increased considerably. As to the instrument with which Mr. Randall had been testing at Waltham Cross, he (Mr. Chapman) had tried one that Messrs. Aird lent him. He used the instrument for testing the mains; but found that, after a time, it was not so effective as when he first applied it. Mr. Randall was a very clever mechanic; and possibly he had improved upon that one, or had constructed an entirely new one. But his (Mr. Chapman's) experience was that after a time the instrument was not so sensitive as at first—the diaphragm seemed to get affected in some way, and the gas did not appear to have the same power upon it to show leakage that it had when he first used it. Mr. Randall had evidently given a great deal of attention to the instrument, and had thoroughly tested its value. He (Mr. Chapman) did not know whether other members in the suburban districts round London had found, as he had done, that the leakage in their districts had tended to increase of late. In his own case, he had no less than sixteen Rural District Councils to deal with, where before they had only one Council, who, with a great district, did not go to the expense of maintaining the roads in the country places. But now steam-rollers were being used everywhere; and this was one reason why the leakage was greatly on the increase in these small localities. He could not see why in a district like Harrow, although it ran about 10 miles from east to west and from north to south, the leakage should have increased as it had done in the last four years since the passing of the Local Government Act which brought into existence these District and Parish Councils. In the Malvern Link arbitration, Mr. Alfred Colson stated that he should advise the taking-up of all the mains, and laying them at a lower level. It seemed to him (Mr. Chapman) that, where they had mains only 2 feet below the surface, they should certainly now put them at least 2 ft. 3 in. or 2 ft. 6 in., to prevent injury by steam-rollers.

Mr. S. W. DURKIN (Southampton) said he had had some rather extraordinary experiences with leakages in his district at different times; for the town had been in a state of chaos, owing to new sewerage works, and the laying of telephone wires and electric light culverts and ducts. While this work was being carried out, the men came across gas-mains and service-pipes pretty freely. It was all very well while the dry weather lasted; but he expected, and was not disappointed, that, when there had been heavy rain, they would find out some of their difficulties. Since Oct. 28 up to Nov. 5, they had broken mains reported every day. This had caused a great deal of trouble. He did not know the instrument Mr. Randall had been employing; but he (Mr. Durkin) had been using a gas indicator about 3 inches in diameter, and had found it uncommonly useful. Especially was this so in one case, where a leakage of gas found its way into the electric light conduits, and travelled on until it got into the electric light works. The street in question was very complicated as far as the gas connections were concerned. They found a broken main under the tramway; and also a leakage on the main close to the trench opened by the electric light people. There they stopped two leakages; but still the smell of gas continued in the electric light works. Therefore they went further afield. There was a main on both sides of the street. They tested one side first; and, detecting gas about, they opened the ground, but could not find any trace of it whatever. After completing the one side, they examined the other. One of the inspectors went along the line of the electric light conduits with a detector; and at different points he found gas in the chambers. They followed the clue up, isolated the main, and put on a test-meter to try and localize it as closely as possible. At last they found a service pipe that had been tapped into the side of the main. A short time before, the steam-roller had been at work there; and the ground being of a spongy nature underneath the pipe, the roller had drawn the pipe out of the main. So this "Will o' th' Wisp" was at last unearthed by the detector and test-meter. At Southampton, they had frequently used these indicators and found them of great service, even without the searching-rod which Mr. Randall drove down by the mains. Leakages were constantly cropping up in streets disturbed by public authorities; and gas managers had to deal with them in the safest possible way. His experience was that detectors were invaluable.

Mr. W. B. MIMMACK (St. Mary Cray) wished to accord his tribute of praise to this instrument, which he had been using for a considerable time. The necessity for something of the kind in his case would be seen when he mentioned that they had about 32 miles of main with a consumption of no more than 60 million cubic feet of gas. It would thus be understood that they had a large area, and a great length of main; and consequently leakage was a very important point with them. It had been at a very high figure, which he should hardly like to mention there. He made several attempts to get hold of an apparatus that would give the percentage of leakage rapidly and easily. He had a thermometer brought to his notice, in which there were two bulbs and stems. One of the bulbs was surrounded by a chemical compound which was stated to be a secret of the inventor. Coal gas would raise the temperature of this compound, and cause the thermometer to go up rapidly; while the other bulb was only acted on by atmospheric temperature, and remained stationary. But there seemed to be some peculiar characteristic about the chemical compound; and at times it did not appear to act with anything like the celerity that it did on other occasions. Then this apparatus working on the law of the diffusion of gas was brought under his notice; and he tried it at once. But on one occasion when an inspector was using it, some of the local authorities peered over his shoulder; and, finding out what it was, became possessed of one. Now they went about the district lifting the manhole lids; and, if a little gas had collected in the sewers, and showed itself on their indicator, they would run down to the gas-works, and say there was an explosive mixture in the sewers, and the matter must be attended to at once. Consequently, they had found out that this instrument, although it had been a blessing to them, had been the cause of a great deal of trouble. By driving down the bar, they could arrive at the percentage of leakage, and whether they were near the seat of it. The nature of the soil into which the bar was driven made a very important difference. Some soils were very porous; and if there was a leakage in the main, it would percolate through the soil very rapidly. On the other hand, if the main was in a clay soil, there might be a considerable leakage, and the detector would not show much of it; and it would be necessary to get almost on the spot to find it out. With regard to traction-engines, matters seemed to be getting worse and worse. In his town they had now a 15-ton roller; and Kent, he thought he was right in saying, was the only county in England where traction-engines were allowed to run riot without having to pay a licence or something of the kind. One morning he stood at the corner of a country lane while a procession of 22 traction-engines went by. After the procession had passed, to his astonishment, he saw a 2-inch gas-main "standing out" of the ground. The side of the road was literally forced out; and the main, in more places than one, stood out about 3, 4, and 5 inches. He was surprised to find the leakage was so small as it turned out to be; but the matter had to be attended to at once. He could not help thinking that it was a pity more severe restrictions were not imposed upon these traction-engines; so that they should not be allowed to run down streets one after the other in any number. As to the 15-ton roller, in nearly every instance where roads had been newly made up, and this heavy roller had been put upon them, they had to attend to serious leakages. Particularly in suburban districts, this matter of localizing leakages was an important one.

Mr. C. E. BOTLEY (Hastings) said he had had some experience with these instruments, and they had been extremely useful in determining the presence of coal gas. He had not, however, found that they always indicated the exact locality of a leakage in some grounds. He had had instances of a strong indication of gas; and the leakage had been at least ¾ mile away. Where this happened, the leakage was most difficult to localize. The instrument had been useful in a case where a man said he had gas leaking into his cellar. They took one of the instruments there, and found there was no leakage of gas, but a sewage smell. By the aid of the instrument they convinced the person complaining that it was not gas; and it was afterwards found that it was a drain that was defective. The instrument had also been found useful in large towns where there was wood or asphalte paving. In one case it was decided that The Gaslight and Coke Company were liable for a leakage of gas which was occasioned by some operations—not their own—on an asphalte road, because this instrument was in existence, and would have informed them of the leakage. He certainly agreed that the instrument was a valuable one.

Mr. F. G. COCKEY (Newport, Isle of Wight) regarded this system of testing as a very satisfactory one, especially for long lengths of main. Starting from one end of a main, and going to the other, very often an indication of a leakage was obtained;

and if the main was followed up with the rod and indicator, as Mr. Randall suggested, the strongest point was almost bound to be discovered. Often indications would be obtained at the top of a hole, but the leakage would be found half-way down.

Mr. D. IRVING (Bristol) remarked that the instrument was well and generally known; but he was sure they were all obliged to Mr. Randall for the example he had brought before the members, which showed what could be done with the instrument, *plus* painstaking energy and application. Mr. Randall had succeeded with this instrument; and his energy in reducing the leakage from 16½ per cent. down to 4½ per cent. was a splendid example of what could be done. He had great pleasure in congratulating him; and what he had accomplished at Waltham Cross could be done elsewhere.

The PRESIDENT observed that Mr. Randall's paper was one well worthy of attention; and the criticisms made upon it were, on the whole, very favourable to the author.

Mr. RANDALL, in reply, said, in answer to Mr. Chapman, that he certainly experienced some difficulty in starting the instrument—it was very sensitive at first, but after a little use it gradually deteriorated. He went to the trouble of taking it to pieces to find out why it deteriorated. There was simply one tap on the instrument to allow the mixture of gas and air to escape; and he came to the conclusion that, if they had two taps instead of only one, they could have a free current of ordinary atmospheric air to clear the instrument, and start *de novo*. Since then they had had no difficulty whatever—they had had no difficulty regarding the sensitiveness of the instrument. What he had been able to accomplish was due to the fact that they had systematically gone over the entire district to discover leakages. Several of the defective pipes which were found were quite eaten away; and the members might well wonder why it was they were not reported before. Some of them were in places where perhaps 2000 or 3000 people passed every day. There must have been a large quantity of gas escaping, but it was never noticed. By this instrument, they were able to "spot" the exact position of the leakage whatever the nature of the soil. Even if they were dealing with ashes (than which he did not think there could be anything more porous), and could get a hole down and were able to keep it open, by putting the indicator on the top, they would most certainly come across the actual leakage, as it would be sure to pass up the hole. It would travel up that sooner than along the bed of the main. After detecting the leakage they seldom had to open more than a yard or two of main. This showed that, where they had to deal with Macadam or wood paving, costing 25s. per yard, the outlay on the instrument would soon be returned—frequently in less than a week.

VOTES OF THANKS.

Mr. CHAPMAN proposed a vote of thanks to Messrs. Botley and Randall for their excellent papers.

Mr. W. A. VALON (Ramsgate), in seconding the motion, said they had to congratulate Mr. Botley upon the success which his process had achieved. But there was something more to be said upon it than had been said—there was something more to be discovered, but that would come in time. As far as Mr. Randall was concerned, he had produced a discussion which was interesting to all gas engineers. Complaints had been made with regard to the breaking of mains by steam-rollers and traction-engines. This kind of thing was no doubt very bad; but steam-rollers and traction-engines had come to stay; and therefore the only thing gas engineers could do was to put their mains down deeper, and not lay them in the slipshod way that some of the older men knew had been done in the past.

The motion was heartily agreed to.

Messrs. BOTLEY and RANDALL having returned thanks, the proceedings terminated.

The members afterwards had tea together.

THE ACETYLENE CONGRESS AT FRANKFORT-ON-THE-MAIN.

The Congress of Calcium Carbide and Acetylene Gas Specialists, which was convened, as already briefly mentioned in the "JOURNAL" of the 18th ult., for the 27th and 28th of September, at Frankfort-on-the-Main, was promoted by the Calcium Carbide and Acetylene Gas Association, of which Herr J. Knappich, of Augsburg, is President. After Dr. H. Rössler had welcomed the visitors to the town of Frankfort, Dr. FREUND, the President of the Congress, called upon Professor Erdmann, of Halle, to make a communication on the "Chemistry of Acetylene."

Professor Erdmann said that the methods of handling calcium carbide in the laboratory had not yet been properly studied. Reactions proceeded either sluggishly or so violently that they were beyond control. For instance, concentrated sulphuric acid had no action on lumps of calcium carbide, but with the powdered substance a very violent reaction occurred. Nitric acid and powdered calcium carbide reacted with explosion. Useful products might be obtained by the action of other substances than water on calcium carbide. Thus Maquenne, by the action of iodine, had discovered periodethylene, which he proposed to employ as a substitute for iodoform. Professor Erdmann examined the new substance, and found it an unsatisfactory substitute for that material. It had long been known that alcohol could be produced by the combination of water and acetylene; but the process did not pay when tried on a commercial scale. An intermediate product—viz., acetaldehyde—which had formerly been obtained from alcohol, could however be produced by leading a fine stream of acetylene into hot dilute mineral acids, to which some mercury had been added. Complex organic substances could also be obtained from acetylene. Pure acetylene had no action on pure copper at ordinary temperatures; but Professor Erdmann obtained a rather remarkable substance by leading acetylene over the finely-divided metal at 446° Fahr. This substance was quite distinct from copper acetylide produced in the wet way. It was non-explosive, and on heating to a high temperature it yielded a light brown oil containing benzene, naphthalene, and other aromatic hydrocarbons, and having a smell resembling that of natural naphtha. Pure carbon could be obtained by heating acetylene. Generally this carbon was in the form of graphite; but as the state in which a substance crystallized could be modified by varying the external conditions, it seemed likely that diamond might thus be obtained from acetylene.

Dr. A. Frank, of Charlottenburg, next read a paper on the "Economic Importance of Acetylene and Carbide Manufacture." He stated that the fears frequently expressed that there was no scope for a new illuminant were groundless, as the present rate of progression in the lighting industries, due to reiterated demands for more and better illumination, indicated rather that fears that the means of coping with the demand would prove inadequate would be better founded. Take, for instance, the immense increase in the consumption of petroleum. In 1879, the production of crude oil in America was 20,000,000 barrels; while in 1897 it had risen to 60,900,000 barrels. Russia in 1880 produced only 2,400,000 barrels; but in 1897 this had increased to 42,000,000 barrels. The gas industry showed a similarly enormous development. The consumption of gas in Germany now exceeded 800 million cubic metres (28,253 million cubic feet) per annum; whereas in 1868 it was only 151 million cubic metres (5333 million cubic feet). Assuming that 400 cubic feet of gas consumed in ordinary burners gave the same amount of light as a gallon of petroleum, the petroleum imported into Germany in 1897 was equivalent, as an illuminating agent, to more than three times the present gas production of the country. Therefore it was absurd to suppose, with some people, that acetylene would ever supplant petroleum. Assuming that acetylene had fifteen times the illuminating value of coal gas, the volume required to displace the petroleum imported into Germany would be about 180 million cubic metres (6357 million cubic feet); and 600,000 tons of carbide would be consumed in its production. Electrical installations of about 500,000-horse power would be needed to supply this quantity of carbide per annum. The illuminating value of coal gas had been increased five-fold at least by the introduction of the Welsbach mantle. There did not even seem to be ground for anticipating that acetylene would displace the electric light; for the latter had special applications, and a better efficiency was expected to be realized shortly. Nevertheless, there was ample scope for acetylene. The whiteness and brightness of the acetylene light were very important advantages. It was necessary, however, for the success of acetylene as an illuminant, that generators should be properly constructed and the gas adequately purified. The use of acetylene in incandescent lighting did not seem promising, as the whiteness and intensity of its flame were by this system completely sacrificed, and only the heating power of the gas was utilized. Large quantities of carbide were already used by the Russian railways for the production of acetylene for admixture with oil gas; and the annual requirements of the German railways, where the mixture of acetylene and oil gas was generally adopted, would amount to 10,000 tons of carbide. Electric lighting works could profitably employ their plant during the hours when the load was light in the production of carbide. In addition to water power, the peat deposits might also be turned to account as a source of carbide, as 16 to 20 tons of peat would yield 1 ton of carbide. In the first half of the present century, Europe looked to other lands for its sugar supply, just as it now did for petroleum. Germany now produced 1,700,000 tons of crude sugar, and exported 1,200,000 tons. Even as, by the aid of science and art, Germany had rendered herself independent of foreign sugar supplies, so might she hope in the future to provide her own illuminating agents; and to this end she should foster the carbide industry.

Dr. Frölich, of Berlin, described a new electric furnace, introduced by Messrs. Siemens and Halske for electro-chemical processes.

Dr. May, of Frankfort, next spoke on the explosion of copper acetylide. He referred to the researches by which Messrs. Pintsch had shown that acetylene did not form an acetylide when passed through copper or brass apparatus. The acetylide could be heated in the open to 140° Fahr. before it would explode. The explosion did not extend to a bulk of acetylene, but was limited to the vicinity of the acetylide.

Dr. P. Wolff, of Berlin, then gave a paper on the "Purification of Acetylene," and therein expounded the systems of purification devised by himself and by Dr. Frank. Dr. Wolff's views on the subject have been given recently in the "JOURNAL" (see *ante*, p. 1032, and p. 1102).

Herr Liebetanz, of Düsseldorf, next discussed the planning of

installations of acetylene lighting. He referred to the difficulties which young or inexperienced technicians found in determining the requisite number of burners for various rooms. Dr. Cohn, of Breslau, had stated that artificial lighting should be equal to 50 metre-candles, in order that a person might read as comfortably as by daylight; and he had given for reading purposes 10 metre-candles as the least illumination compatible with hygienic requirements, and for general lighting 4 or 5 metre-candles. But his laws assumed that the whole of the light was derived from one source, which radiated equally in all directions. In practice, many considerations influenced their application. Reflection from surrounding objects played an important *rôle*. Yellow walls reflected 40 per cent. of the light which fell upon them, while dark brown walls reflected only 4 per cent. In the lighting of wide streets and open spaces reflection did not come into play, because of the absence of walls. The number of candles per square yard of area which gave adequate illumination would be about as follows: In living rooms, 3 to 3½; in bedrooms, 1½ to 2½; in passages, 1 to 2; in offices, 3 to 4; in shop interiors, 5 to 7; in ball-rooms, &c., 10 to 13. Street lighting would be good if the lamps were 30 yards apart and afforded at least 2 candles per square yard of ground. Moreover, the effects of globes and shades had in many cases to be taken into account, as by such means the intensity of the light in particular directions might be greatly increased or decreased. With regard to the diameter of services for acetylene, Herr Liebetanz was of opinion that it was best to use the same sizes as for coal gas, though a reduction to one-third the diameter was generally recommended.

Herr Herzfeld, of Augsburg, next spoke on the "Storage and Transport of Carbide." He said that the regulations varied in different countries, but were in most cases too stringent. Carbide must usually be kept in hermetically sealed vessels, and this was commonly understood to mean soldered vessels. But if the carbide happened to be damp at the time of packing, very high pressures were produced in the soldered vessels. In some cases, safety-valves opening at a certain pressure were now required to be fixed in the lids of the vessels. It was unnecessary to prohibit the storage of carbide in cellars; and in towns it was impossible to find any other accommodation. In closed vessels, carbide was certainly no more dangerous than spirit and petroleum.

Herr J. Knappich, of Augsburg, then gave a communication on the attitude of fire insurance companies towards acetylene. He discussed the regulations imposed by some German, Swedish, and American Insurance Companies, and expressed the view that they were unnecessarily stringent. He hoped that the Companies would consult the Association as to the regulations which should be enforced with regard to the storage of carbide and the use of acetylene installations.

The railway station at Kronberg was, as an experiment, lighted by acetylene on both days of the congress, and was visited by the members of the Association.

SOCIETY OF CHEMICAL INDUSTRY.

Opening Meeting of the London Section.

The current session of the Society of Chemical Industry opened on Monday, the 7th inst., when Mr. BOVERTON REDWOOD took the chair at the first meeting of the London Section. He called upon Mr. Watson Smith to give two communications—(1) on a Central American lignite, soluble in benzol, and (2) an exhibit of Miike coal with shale and fossils.

The sample of Central American lignite had the appearance of a good bituminous coal, except that small particles were brown instead of black. The precise locality whence the sample came was not known. When heated in a flame, it burnt like cannel, while the warmed portions melted like sealing-wax. It differed from the bitumens properly so-called in that it conducted heat. Its softening point was found to be between 570° and 610° Fahr. Its specific gravity was 1·26. On prolonged extraction with benzene, no less than 80·1 per cent. of the substance was dissolved. The Miike coal, from Kiushiu Island, Japan, extracted with benzene in the same manner, yielded only 9·5 per cent. of soluble resinoid matter or bitumen. The bitumen obtained by the extraction of the Central American lignite began to distil between 248° and 266° Fahr.; and 20·4 per cent. passed over below 302° Fahr. A viscid mass remained at the close of the distillation. The odour of the products resembled that of petroleum. The lignite yielded only 3·76 per cent. of ash; but it contained no less than 9·1 per cent. of sulphur. The amount of iron in the ash was only 0·41 per cent. of the lignite; and the pyrites equivalent to this quantity of iron would contain sulphur equal to only 0·5 per cent. of the lignite. The balance of the sulphur—8·6 per cent. of the lignite—must therefore be in some organic combination or as free sulphur.

Destructive distillation of the lignite on a small scale showed a yield of 44·8 per cent. of coke, 12·4 per cent. of tar, and gas equivalent to 8899 cubic feet per ton. The results indicate that the lignite could be used for gas making; but the coke would be friable, and the tar would be of little value. The ash consisted chiefly of silica; hence the lignite probably occurred in the sandstones and above the true coal measures.

Mr. Boverton Redwood considered that the lignite in question bore a close resemblance to certain bitumens from Utah and Colorado, and to the well-known mineral "Albertite," which occurs in New Brunswick, and is reported to yield on destructive distillation 100 gallons of oil and 14,500 cubic feet of illuminating gas per ton.

Mr. Dann, the Chief Engineer at the Japanese mines at Miike, gave some interesting details of the mining and uses of the coal worked there, which has previously been referred to in the "JOURNAL," Vol. LXI., p. 454. About 4000 acres had already been mined. There was no bed of stone above the coal-seams, and hence water soaked through from the surface to the working levels. In some places lava had flowed over the coal-seams, and had converted the coal into a natural coke. The mining was done almost entirely by means of convict labour, which proved very efficient. A considerable amount of coke was made from the Miike coal in beehive ovens. The yield of coke was only 51 per cent. of the coal; but close ovens were now being constructed, and with them a yield of 60 per cent. was anticipated. The coal was used very generally as gas coal in the Japanese and Chinese markets. It was found that 1 lb. of the coal would evaporate 8½ lbs. of water from the boiling-point. Certain fossils found with the Miike coal had been examined at the Jermyn Street Museum; and though the majority of them were too ill-preserved to be of much service, the evidence they afforded tended to support Mr. Watson Smith's contention that the Miike coal was really a lignite and not a true coal.

THE PRESENT POSITION OF ACETYLENE LIGHTING.

Dr. Paul Wolff's Berlin Lecture.

(*Continued from p.* 1033)

The after-development constitutes a second difficulty in the generation of acetylene. The evolution of gas does not cease when the water supply is interrupted, because a quantity of moisture remains in the carbide receptacle, and is converted into acetylene. The heat of the reaction vaporizes water, which subsequently condenses and reacts with the carbide; while water combines with lime at about 140° Fahr., and is removed from it when cold by the carbide. A carbide receiver, if opened immediately after the generation of gas has been interrupted, will be filled with a damp mixture of unconsumed carbide and lime sludge; but if it be left for twelve hours before opening, the contents will be dry and the moisture will have gone to form acetylene. Carbide is a most hygroscopic material, and it eagerly seizes every trace of moisture.

Various means have been tried to regulate the development of the gas. In order to moderate the violence of the reaction, substances which have no action on carbide—such as alcohol, acetone, or glycerine—have been added to the water, or the carbide has been protected by oil, petroleum, or other water-resisting material. Substances such as sugar have been employed to dissolve the lime liberated, and thus prevent the accumulation of a coating of lime on the carbide. Against all these means may be urged their cost, which would quite preclude their employment on a large scale. They are also inefficient. Numerous experiments with the majority of the proposed means under varying conditions invariably had unsatisfactory results. Oil or petroleum, if in small quantity, scarcely retards the reaction; and if in large quantity, it completely stops it. The attenuation of the water retards the development of the gas; but the effect is not satisfactory. Alcohol, acetone, and other readily volatile liquids are volatilized by the heat of the reaction, and affect the intensity and colour of the acetylene flame. Concentrated aqueous solutions of salts liberate the gas almost as rapidly as does water. The use of sugar has not the desired effect, as the quantity which can be used is too small to form a soluble compound with the whole of the lime. Even if substances—such as hydrochloric acid—which dissolve lime much more freely are used, the results are not satisfactory. Some of the substances mentioned may prove useful in experimental work; but they cannot be of service on a practical scale.

A third source of danger in the generation of the gas is the development of heat which occurs. The temperature of decomposition of pure acetylene is about 1436° Fahr.; that of its mixture with air, about 896° Fahr. It therefore becomes very necessary to ascertain if these temperatures can be attained in the generator. The temperature which can by theory be reached will be found by calculation to be about 2012° Fahr.; but in reality so high a temperature is never attained, because the heat is dissipated, especially by conduction through the outer walls of the generator, and by absorption by the water. The actual temperature reached varies very greatly according to the design of the generator.

All the difficulties which have now been referred to must be taken into consideration in the construction of apparatus. Three factors are of importance in every acetylene installation designed to work properly—viz., the generation, the purification, and the combustion of the gas.

Generators are of three classes—namely, (1) those of the "dip" system, which resemble in principle Kipp's apparatus; (2) those of the "drip" system, in which water drops on to carbide; and (3) those in which carbide is plunged into a large

excess of water. Generators of the first class were the early favourites, because of their simplicity. The general plan was to place the carbide in a basket within a bell, which floated in a tank of water. The lower portions of the carbide came in contact with the water; gas was generated and raised the bell, and thus removed the carbide from contact with the water and interrupted the generation, until, owing to consumption of the gas, the bell sank and brought the carbide again into contact with the water. There are serious faults in this plan of generation. The after-development is very great, as more water is always taken up by the carbide when it dips into the water than corresponds to the consumption; and the surplus causes a continuous generation of gas. This surplus water, however, is exhausted after awhile; and the amount of gas which would be developed by it can be determined and allowed for. But the aqueous vapour arising from the water in the tank continues to act on fresh carbide, and causes an after-development of gas which continues so long as any carbide remains. Experiments have shown that the total after-development from 1 kilo. of carbide (2·2046 lbs.) amounts to 7·5 litres (0·265 cubic foot) in the first half hour; to 25 litres (0·883 cubic foot) in the first 24 hours; and to 50 litres (1·766 cubic feet) in three days. It then becomes regular, and amounts to 5 to 6 litres (0·177 to 0·212 cubic foot) for every 24 hours, so long as any carbide remains. The complete avoidance of this after-development is practically impossible; but it may be reduced by diminishing the surface of the water as much as possible.

An even more serious disadvantage of generators of this class is the great development of heat which occurs. Whenever the carbide is brought in contact with the water, aqueous vapour is formed and takes up a considerable part of the heat of the reaction; but the aqueous vapour rises through the mass of unattacked carbide, and causes evolution of gas and a fresh development of heat. The process repeats itself continually, and there results eventually a rise of temperature not far below that which is theoretically possible. The author has observed that when the diameter of the carbide holder exceeds a particular size, so that a certain minimum amount of carbide is brought into contact with the water each time the holder dips into it, the temperature becomes so high that the whole, or at least a part, of the carbide is incandescent. Enveloping the generator with a water-cooler has often been recommended, and has been stated to prevent over-heating. Such a recommendation displays gross ignorance of the actual conditions. The generation of acetylene takes place with violence and suddenness, and can give rise to a temperature of nearly 1832° Fahr.; and a superficial and incomplete method of cooling such as that referred to, can have no considerable effect—especially as both carbide and lime are very bad conductors of heat. Thus it happens, as the author has repeatedly observed, that a portion of the carbide in the generator is incandescent, while the surrounding cooling-water is not above 120° or 140° Fahr. All tests of the temperature of the cooling-water while the generator is at work are quite valueless, as they afford no indication of the actual temperature within the generator. Heating to or above the temperature of decomposition of acetylene does not, however, necessarily cause an explosion; for, as has been already stated, the decomposition has not an explosive character under ordinary pressures. But if the generator contains air, as it usually does when first put in action, an explosion may result. In all cases, however, where a decomposition of the acetylene takes place, products of its polymerization are found; and these not only adversely affect the illuminating value of the gas, but cause stoppage of the services and burners. Styrol, naphthalene, and tar are found among the complex mixture of the products of the polymerization of the gas. The "dip" generators are therefore very unserviceable, and even dangerous unless of very small size. The charge of carbide should never exceed 1 kilo. (2·2046 lbs.) in generators of this class.

The second class of generators consists of those in which water drops on to carbide. The carbide is usually in one or more receptacles, which communicate with a cistern of water by means of a pipe. The flow of water through this pipe is controlled according to the movements of the bell of the gasholder into which the gas passes as it is generated. The patent claims refer chiefly to the devices by which the regulation of the flow of water is effected. Generators of this class have the faults of those of the first class on a moderated scale. The heat evolved when a drop of water falls on the carbide vaporizes a part of the water, and the vapour rises and escapes with the generated gas, without coming in contact with more carbide. The cumulative development of heat is not found as in generators of the first class. The temperature of decomposition of acetylene does not appear to be reached so long as the apparatus is of such a size that the water actually drips on to the carbide, and does not fall on it in a continuous stream. If it runs on to the carbide in a stream, an excess of water is certainly present; but it is insufficient to decompose the whole of the carbide and to absorb the heat which is evolved, yet enough to cause a continuous after-development and rise of temperature. Very high temperatures can thus be attained. A limit must therefore be set to the size of drip generators. The author's researches lead him to recommend that the charge of carbide in generators of this class should never exceed 3 kilos. (6·614 lbs.).

For all larger installations, apparatus in which the carbide is discharged into a large excess of water should alone be used. Each piece of carbide is thus completely decomposed, so that there can be no after-development; while the heat of the reaction is absorbed by the water, and a considerable rise of temperature is avoided. Repeated trials showed that even when such apparatus was worked to its utmost capacity, the temperature did not exceed 122° Fahr. Endeavours to secure automatic regulation of the generation of gas with this class of apparatus have not been attended with success owing to the nature of carbide, which is a hard material in lumps of irregular shape and size. Automatic feeding appliances only act satisfactorily with a material consisting of uniform granules or of powder. It is difficult to bring carbide into this condition, and loss occurs during pulverization owing to the action of atmospheric moisture on it. Hence it appears to be the best plan to dispense with automatic regulation in all large generators, and to supply the carbide by hand. It is essential, however, that gas should not escape when the carbide is introduced, and that air should not be carried into the apparatus with the charge of carbide. These conditions may be secured by providing the generator with a hydraulic seal.

Purification plays an important *rôle*, because commercial carbide invariably contains a number of impurities which are decomposed by water and yield gaseous products which contaminate the acetylene. The nature and amount of the impurities vary very much, according to the degree of purity of the raw materials used in the production of the carbide. Analyses of the acetylene formed from three comparatively good varieties of commercial carbide showed the following mean results in volumes per cent.:—

—	Sample A. (American.)	Sample B. (German.)	Sample C. (Swiss.)
Acetylene	98·41	99·01	98·63
Oxygen	0·87	0·55	0·63
Nitrogen	0·42	0·20	0·34
Hydrogen	0·09	0·07	0·16
Sulphuretted hydrogen	0·08	0·07	0·10
Phosphuretted hydrogen	0·05	0·03	0·03
Ammonia	0·08	0·07	0·11
	100·00	100·00	100·00

There are also sometimes found, siliciuretted hydrogen, arseniuretted hydrogen, and organic sulphur compounds.

The small quantities of oxygen, nitrogen, and hydrogen are of no moment, and may be ignored; but the ammonia, sulphuretted hydrogen, and phosphuretted hydrogen may cause a great deal of trouble, and so their removal is absolutely essential. Ammonia conduces to the formation of the explosive copper acetylide; and sulphuretted hydrogen is poisonous. Phosphuretted hydrogen, however, is the most noxious impurity, because in the first place it corrodes the metal parts of services, cocks, burners, &c. (especially when the metal is copper or one of its alloys), and renders them useless. The impurities, moreover, give rise to noxious products and injure the illuminating power when the gas is burnt. Especially is this true of the phosphuretted hydrogen, which fills the air with a cloud of phosphoric acid distressing to the respiratory organs. The greatest risk arises, however, from the spontaneous inflammability of phosphuretted hydrogen, and more particularly of siliciuretted hydrogen. The presence of air consequently can cause disastrous explosions; and many apparently inexplicable mishaps can be ascribed to the presence of these spontaneously inflammable impurities.

The formation of the various impurities is not very readily explained. Ammonia arises from nitrogen compounds of calcium and magnesium, which are decomposed by water. Sulphuretted hydrogen occurs if the raw materials contain sulphur, though it is uncertain in what combination the sulphur exists in the carbide. The formation of calcium sulphide seems probable; but this substance is not decomposed by water, and therefore it could not yield sulphuretted hydrogen. It has been assumed that at the temperature of the electric furnace an aluminium sulphide (Al_2S_6) is formed; and this substance decomposes on contact with water. But whether this sulphide is formed seems uncertain; and the author has undoubtedly often detected sulphuretted hydrogen from samples of carbide which were quite free from aluminium. It seems probable that there are in carbide certain complex organic sulphur compounds, which are decomposed by water at a certain temperature, and form sulphuretted hydrogen. Lunge and Cedercreutz have shown that such organic sulphur compounds probably occur in acetylene. The formation of phosphuretted hydrogen is more easily explained; for if phosphorus occurs either in the coke or the lime as phosphate, it will be reduced in the electric furnace to calcium phosphide, which liberates phosphuretted hydrogen as soon as it is brought in contact with water. It is more difficult to find an explanation of the occurrence of siliciuretted hydrogen. If the raw materials contain silica, there may be formed silicon carbide, ferro-silicon, magnesium silicide, or calcium silicide. Silicon carbide (or carborundum) and ferrosilicon are insoluble in all solvents; while the silicides only give rise to siliciuretted hydrogen when they are treated with acids. We must therefore assume that complex silicon compounds of uncertain composition, which yield siliciuretted hydrogen when treated with water, are found in the carbide. The reactions which really take

place in the present electric furnace have not been sufficiently studied; and there is no doubt that unrecognized minor reactions, which produce novel compounds, occur simultaneously with the well-known main reactions.

The safest means of avoiding impurities lies in the careful selection of the raw materials. Lime which is as nearly pure as is possible, and contains no phosphate, sulphate, or silica, and coal which is free from sulphur, yield a carbide which produces almost pure acetylene. But as the prevailing materials have to be used, and as coal (being a product of organic substances) is never free from phosphorus, purification of the acetylene must be considered as indispensable. Ammonia and sulphuretted hydrogen are likewise impurities of coal gas; and the gas industry has long since found the best means of separating them from gas. Ferric oxide, or other ordinary purifying materials, do not, however, remove phosphuretted hydrogen. Numerous agents which have been proposed have nearly all proved useless, either because, like ferric oxide, they do not attack the phosphuretted hydrogen, or because, like bromine, permanganate, &c., they act so energetically that they partially decompose the acetylene.

Two methods of purification which have given satisfactory results may be described. The first, which has been invented and patented by Herr A. Frank, consists in washing the gas with acid solutions of metallic salts, of which a concentrated solution of copper chloride in hydrochloric acid answers best. The ammonia is absorbed by the acid; and the sulphuretted hydrogen and phosphuretted hydrogen are precipitated as copper sulphide and copper phosphide. All the impurities are thus removed at one operation; and the method is therefore very suitable for use with a small plant. Its application on a large scale demands careful consideration, because the acid nature of the reagent precludes the use of metal vessels; while the removal of the precipitate is not easy, and the acidity of the agent must be maintained in order to prevent the formation of copper acetylide. The acetylene, moreover is attacked and absorbed to some extent, and is partially oxidized to aldehydic compounds. Nevertheless, with care, this method gives good results.

The second plan is one elaborated by the author. Lunge and Cedercreutz recommended chloride of lime for the technical purification of acetylene, but their system needed amplification in order to make it serviceable. The author found that the passage of crude acetylene through purifiers charged with chloride of lime caused explosions, which proved to arise, not from the acetylene, but from the ammonia in the gas, which formed chloride of nitrogen with the chlorine of the chloride of lime. The sulphuretted hydrogen is only partially retained by this material. It was therefore necessary to remove the ammonia and a portion of the sulphuretted hydrogen before the gas entered the vessel containing chloride of lime. The removal of these impurities can be effected by merely washing the gas in an efficient washer; but it is preferable to intensify the action of the water by adding to it calcium chloride or a similar substance. The phosphuretted hydrogen is subsequently oxidized by chloride of lime (bleaching powder), or some other oxidant which is without action on the acetylene. This scheme of purification is adopted in the Pictet generating apparatus as made in Germany. (The apparatus was briefly described in the "JOURNAL" for Oct. 4, p. 744.)

(To be continued.)

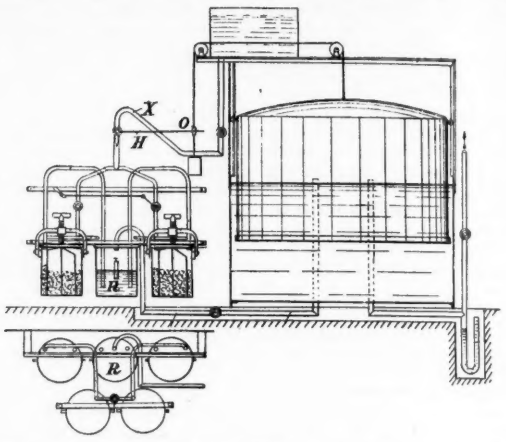
The Extension of the East London Water Company's Mains.—At a recent meeting of the St. Pancras Vestry, sanction was given to an application from Mr. W. B. Bryan, the Engineer to the East London Water Company, for permission to lay, before next summer, a new 36-inch main, commencing in the Camden Road and passing to the York Road. The application was made because the Company have no statutory powers outside the line of their existing 36-inch main running from west to east through St. Pancras, though they have such power throughout Islington. Mr. Bryan stated that the Company intend to introduce a Bill next session, in which, if necessary, the length of main in question would be included. It was, however, highly desirable that the pipe should be laid before next June; and if the Company had to wait for statutory powers, the work would be delayed for at least nine months. The Highways Committee of the Vestry expressed the opinion that it would be advisable to render the Company every facility for developing the capacity of their works, so as to afford a more adequate supply of water in the district; and it was upon their recommendation that the request was granted.

Accidental Poisoning by Water Gas at Manchester.—Last Tuesday, an inquest was held at Manchester on the body of John Clelland, age 21, lately foreman of the water-gas plant at the Bradford Road gas-works of the Manchester Corporation, who was suffocated while following his employment on the previous Sunday. The deceased, who was formerly employed at the Belfast Gas-Works, went to Manchester about two years ago. It was part of his duty to attend to the working of a gas-cooling chamber. In spite of a warning by Mr. Rodgers, the Station Manager, never to go down the manhole, Clelland descended on Friday, and again on Sunday. His last venture proved fatal. He was overpowered by the fumes; and on an alarm being raised, the yard foreman —a man named John Mason—bravely attempted to rescue him. Feeling that the fumes were also overcoming him, Mason was obliged to ascend and get assistance. Eventually the unconscious man was got out by means of a rope. Oxygen was at once administered to him; but he never recovered consciousness, and died at the Ancoats Hospital the same day. In recording the jury's verdict of "Accidental poisoning by water gas," the Coroner said Mason's attempted rescue was a noble act, and the Gas Committee should be proud of such a workman.

REGISTER OF PATENTS.

Producing Acetylene.—Wartenweiler, A., of Engwang, and Spengler, R., of Hasli, Switzerland. No. 23,547; Oct. 13, 1897.

The inventors employ a series of generators and a water-reservoir situated over them, and connected therewith by a pipe X. The generators are in communication with a condenser or washer R, by means of pipes which reach nearly to the bottom. It is connected by a pipe with the holder, into which the gas is forced. The bell of the holder is provided with a counterpoise, so that the pressure is to a suitable extent decreased within it, so as to prevent the back-pressure forcing the water out of the condenser. The generators are connected so that only two of them may be worked together, while the remaining generators are shut off. In order to prevent a too sudden generation of the gas, the generators are provided with radial partitions (preferably of unequal



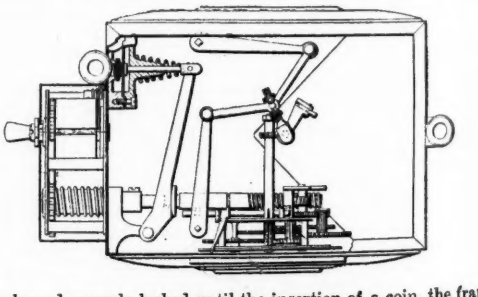
height), so that the chambers within the vessels are successively brought into action by the water. The gasholder inlet-pipe is preferably provided with a three-way cock, to enable any excess water to be drawn off; and the discharge or escape pipe is provided with a syphon through which excess water from the holder flows. The gasholder has its bell running between guides; and the cord which carries the counterpoise has a stop O, with which a lever H, connected to the water-cock, engages; the arrangement being such that, as the bell is raised, the lever is depressed, and the supply of water cut off or regulated, so that less gas is generated.

Preserving Carbide, and Its Subsequent Treatment for Producing Gas.—Lundstrom, C. J., of Stockholm. No. 23,793; Oct. 15, 1897.

The patentee claims that experiments he has made prove that, if carbide of calcium be covered or impregnated with a matter indissolvable, or hardly dissolvable in water—for instance, oil or turpentine, or similar matters or mixtures of them—the carbide can afterwards be placed in water for a long time without decomposition taking place. The carbide can again be made sensitive to the influence of water, either by heating it or by treating it with such matters as partly at least have a solvent influence on the matter used for the impregnating of the carbide—such as sodium lye, a solution of boric acid, or the like, or by mixing the water to be used for developing the gas with matters like these. For instance, carbide saturated with oil and insensitive to water is decomposed by a solution of boric acid or sodium lye, or by a solution of soda or similar material.

Coin-Freed Meters.—Simpson, S., of Exeter. No. 24,829; Oct. 26, 1897.

This invention relates to coin-freed mechanism of the type in which a measuring wheel, disc, or shaft is rotated in one direction by an operating handle, so as to turn on the supply and set the meter in operation, and in the opposite direction by the ordinary registering mechanism of the meter, so as to cut off the supply when the quantity of gas prepaid has been consumed—the operating handle being normally locked, so as to prevent it from turning until released by the insertion of a coin, or by the action of a coin in a coin-holder. It comprises improvements whereby the operating handle



is positively and securely locked until the insertion of a coin, the fraudulent operation of the mechanism effectually prevented, and the quantity of gas supplied in exchange for the coin accurately adjusted.

The improvements are particularly applicable to coin-freed mechanism such as that described last week (p. 1035) in patent No. 22,830, in which a coin-holder is employed having the coin-slot parallel to its axis, and in which the usual measuring disc or wheel is replaced by a longitudinally moveable measuring shaft, as shown in the plan given of a dry gas-meter (with the top cover removed).

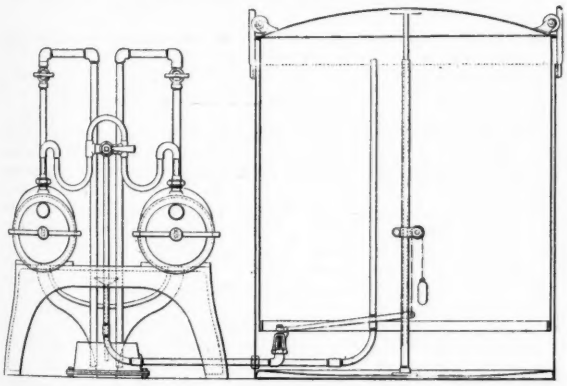
Coin-Prepayment Apparatus for Supplying Water.—Barr, J., of Kilmarnock. No. 25,064; Oct. 29, 1897.

This apparatus comprises (according to one modification) a tap or supply valve which, when opened, closes automatically whenever the quantity has passed for which the parts are proportioned and adjusted. The valve-piece which closes with the pressure up against a seat is loose on a spindle which is depressed to open the valve; and it is formed with a piston working in a cylindrical chamber in the valve box. Below the valve-piston is a separate piston, also loose on the spindle; and between the two pistons there is a helical spring tending to keep them apart. On the lower end of the spindle is fixed a small valve arranged to close up against the opening in the lower piston through which the spindle passes, and which opening, as well as that in the upper or valve spindle, is slightly larger than the spindle. A helical spring placed between the bottom valve and the bottom of the valve-box raises the spindle after having been depressed. When the valve-spindle is depressed, water from under the bottom piston passes up round the spindle to the outlet; whereupon the pressure depresses the valve piston and opens the outlet-port. But the valve-piston immediately begins to rise again through the action of the spring between the two pistons and of the pressure water getting between them past the piston, which does not fit tightly.

The valve-spindle is acted on by a lever, the handle end of which projects through an opening in the external casing of the apparatus. This lever is made with a crank arm, which acts on a small bar fitted to slide in a guide, along which it is moved on the lever being depressed to open the valve. This motion is, however, prevented unless a coin has been placed in a slot provided for it; the movement of the lever being obstructed by a stop formed on a sliding-piece, which is made with a holding part to temporarily retain a coin, and with an opening smaller than the coin. When no coin is in the holding part, the bar passes through without action; but when a coin is there, the bar acting on it moves the sliding-piece, and so removes the stop and allows the lever to be fully depressed. The sliding-piece, in moving as described, carries the coin over a slot, through which it drops into a receptacle. Counting mechanism is arranged to be acted on by the sliding-piece, so as to record the number of times supplies of water have been taken.

Manufacturing Acetylene.—The Acetylene Light Syndicate, Limited, and Gore, J., of Trowbridge. No. 25,952; Nov. 8, 1897.

This apparatus for the manufacture of acetylene is of the class in which two generators, designed to be successively brought into operation, are provided with means whereby after the contents of one generator have been exhausted, the water will be caused to automatically enter the other generator. In apparatus of this kind, as heretofore constructed, a series of cocks has been provided for shutting off the water and gas from the exhausted generator, so as to permit of emptying and re-charging them; and the object of the present invention is to dispense with the use of cocks and to provide "improved means for controlling the supply of water to the generator in operation."



As shown in the engraving, the patentees arrange in the water-supply pipe a single cock, which serves to direct the water into one generator or the other as desired. This distributing-cock has preferably a hollow plug, through which the water enters, and a single opening at the side, through which the water leaves. The pipe between the distributing-cock and each generator is formed with a dip or bend for containing water, which prevents gas from the generator entering the water-supply pipe, or passing from one generator to the other. A bye-pass around the distributing-cock connects the water-supply pipe of the two generators, so that when one generator is full water can flow into the other generator.

In order that the supply of water to the generator and the consequent generation of gas may approximately correspond with the demand, a sliding holder is arranged in conjunction with the generator; and a valve which controls the water supply is operated by the holder when it falls to a certain level. In practice, it is found advantageous to operate the valve through the medium of a rod which extends up to the centre of the crown of the holder; the lever and other parts of the valve being counterbalanced, so that the amount of work which the holder has to perform in operating the water-supply valve is reduced to a minimum.

The pipes through which the gas from the generator flows to the holder are not continuous—a water-trap being arranged into which dip the gas-discharge pipes upon the generators.

Atmospheric Gas-Burners.—Fletcher, T., and Fletcher, Russell, and Co., Limited, of Warrington. No. 26,834; Nov. 17, 1897.

The claim made for this arrangement of burner is that it will, "when in use, be incapable of lighting-back, shall give complete combustion of the gas, and at the same time be incapable of becoming choked."

The burner-outlets, at which the mixed gas and air are ignited, are of equal size, and formed in a vertical inclined or protected face or surface; and each outlet, if not protected by the form of the burner from matters falling vertically upon it, is provided with such protection in cases where the outlets are likely to become obstructed by such matters. Between the outlets and the pipe leading the mixture to the burner (the mixing-tube) is a diaphragm or partition of metallic gauze, with perforations in it not exceeding about one-sixteenth of an inch across. "The size of the holes in the burner is such that the sum of the areas of the outlets is equal to the sum of the areas of the perforations or passages in the diaphragm or partition, and each sum should separately equal the cross sectional area of the mixing-tube." A burner constructed according to these improvements is said to produce "a brisk, vigorous flame with the maximum power, whereas hitherto when a perforated or metallic gauze diaphragm or partition has been employed in the body of the burner, the flame has been generally dull and sluggish, and there has been a loss of efficiency and a liability to burn on the surface of the gauze, when the flame is turned low."

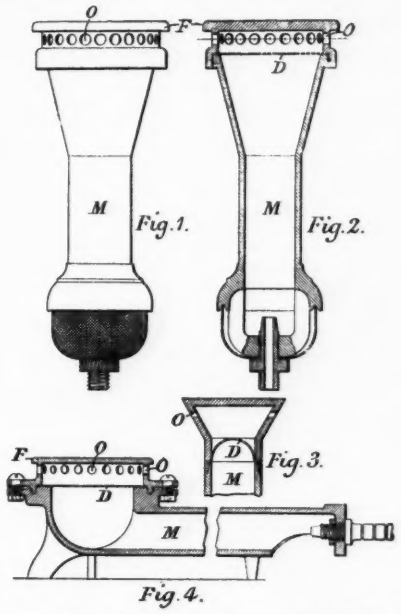


Fig. 4.

Different forms of the burner are shown. O indicates the burner-outlets; D, the perforated or metallic gauze partition; and M, the mixing-tube of the burner. In figs. 1, 2, and 4 there is a flange F above the outlets, to protect them from dripping matter. In the form shown in fig. 3, the projecting upper part substitutes the flange F. In fig. 3 (where the partition D has to be fixed in a position where the openings through it, if flat, could not possibly have a total area equal to that of the mixing-tube M on the one hand, and to the total areas of the outlets on the other hand), it is more or less dome-shaped, or arranged in a sloping position, so as to obtain the necessary area. In fig. 4, the diaphragm, being much larger than the mixing-tube, may be advantageously constructed of perforated sheet metal, having holes to the required number and size formed in it.

Igniting Gas by Its Own Action.—Thompson, W. P.; a communication from H. Schimmel, of Charlottenberg, near Berlin. No. 28,110; Nov. 29, 1897.

This invention has reference to self-igniters for gas which, by their own action, grow hot when a stream of gas passes over them, and which render a fine platinum wire incandescent so that it lights the gas. In employing this kind of self-igniter, it sometimes occurs that the igniting wire is not heated enough by the self-heating body, so that it might light the gas. The invention takes advantage of the well-known fact that platinum and other substances used for preparing self-igniters grow hot by their own action, even in a stream of gas of a very low temperature, when they are in a very finely-divided form—named platinum black or "platinum mohr;" while platinum of a less finely-divided form (platinum sponge) heats itself only in a stream of warmed gas, or when the platinum sponge is itself warmed. The patentee points out that platinum black must be produced in the pores of a porous material (as shown by Duke in his patent No. 969 of 1895), in order to prevent it coalescing to platinum sponge, and thus becoming unfit for lighting gas. This, he says, is the reason why it is impossible to connect the igniting body with the igniting wire so intimately that the heat of the igniting body is transmitted in every case in such a degree that the gas is ignited. On the other hand, there is no difficulty in producing platinum sponge on the igniting wires so that an intimate connection with them exists.

The object of the present invention is to provide the igniting wires near the igniting body with a small knob, or several small knobs, or a thin layer of platinum sponge—called "an igniting body of the second order." When employing igniting wires of this kind, the process of ignition will proceed in the following manner:—

First, the igniting body containing platinum black will grow hot when a stream of gas passes over it. The heat of the igniting body of the first order will then be partially transmitted to the igniting wire; and though perhaps sometimes not sufficient to render it incandescent, it will in every case warm the wire to such a degree that the small knobs of platinum sponge grow hot by their own action in the stream of gas. The warming of the "igniting bodies of the second order," which are directly fixed to the igniting wires, will not fail to warm the igniting wires to such a degree that they become incandescent and light the gas. The lighting of the gas would also take place if the igniting wires did not

become incandescent; for platinum sponge "possesses by itself the property to light a stream of gas when it is somewhat warmed, and thus rendered capable to grow hot by its own action."

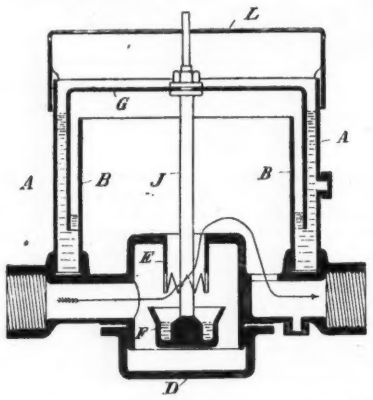
This method of preparing the igniting wires of self-igniters renders it possible to make them out of any other refractory material, instead of out of platinum—for example, out of asbestos. In this case, the wires or refractory threads connected with the igniting bodies of the first order are not igniting wires, but only serve for holding the igniting bodies of the second order, which in this case have their heat transmitted to them by radiation from the igniting body of the first order.

In practice, the Duke igniter above referred to (consisting of an igniting body containing platinum black connected by a simple wire of platinum) would be treated with a solution of a salt of platinum, or of another metal of the platinum group—say, chloride of platinum—in such a manner that a drop or two adheres to the wire near the igniting body. This being done, the solution adhering to the igniting wire would be evaporated, and the remaining salt of platinum reduced to platinum. When employing chloride of platinum, it is sufficient to heat the igniting wire. For this purpose, it is advantageous to bring the igniter in a stream of gas so that it heats itself by its own action. Then the fluid evaporates; and the chloride of platinum is reduced to platinum only by the action of the heat.

Gas-Regulating Device.—Sondermann, E., of Dresden. No. 13,984; June 23, 1898.

The centre part of the gas-conduit shown in the engraving is enlarged; and the bottom of this part is normally closed by a gas-tight cap D. In its upper portion is sunk a short pipe E, having its under end serrated. Affixed to the conduit are two shells, A B, in such way that a water-tight vessel is formed by the space between, which is filled with a fluid, such as glycerine. G is a bell which is telescoped into the space between the shells, and to which is attached a rod J having its under end threaded. This under end passes through the centre of the short pipe E, and has attached to it a dish F (containing mercury), which is lifted by each upward movement of the bell G and rod J, and in the same ratio.

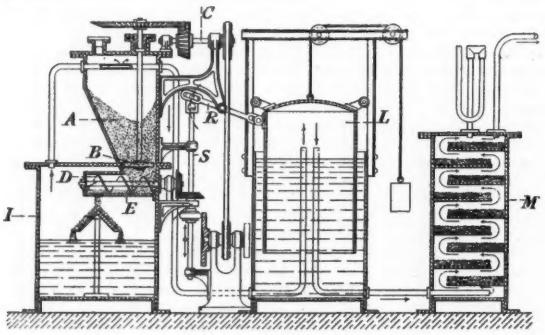
Assuming the bell G, the cap D, and the dish F, not to have been yet fitted, the first thing is to put the bell into position by telescoping it between the shells A B The end of the rod J will then project beyond the under serrated end of the short pipe E, so that the dish F can be screwed on. The cap D is then attached, and the apparatus is ready for work when covered by a hood L.



In previous devices of this description, says the patentee, the valve is formed by the contact of mechanical parts, while in his invention the agent for regulating the current or pressure is a fluid. "With a fluid there is no friction; and the serrated end of the short tube E enables the regulation to be effected to the finest possible degree."

Generating Acetylene.—Bollé, C.; a communication from P. Dreske, of Berlin. No. 11,964; May 26, 1898.

This is an apparatus for generating acetylene by dropping calcic carbide into water; the arrangement for doing this being driven from an independent continually rotating motor in combination with mechanism operated by the rise and fall of a gasholder, and so arranged that the rotation of the carbide-delivering mechanism is stopped and started, or its speed reduced or increased, by the rise and fall of the holder, without stopping the motor or altering its speed.



The carbide (suitably crushed or granulated) is filled into a conical hopper A, the bottom of which is closed by a perforated disc B, which supports most of the weight of the carbide, and is fixed to a vertical shaft passing through the cover of the hopper, and rotated from a laterally arranged shaft C through bevel wheels. As the disc is revolved, the carbide resting on it drops through the perforations on to a worm-conveyor D (enclosed in a trough E), the shaft of which is rotated from a shaft driven by a motor not represented on the drawing. The shaft C is rotated by belt pulleys and a belt, or in any other convenient manner.

As the conveyor is rotated, the carbide falls on a "roof-shaped" distributor, off which it slides into the water contained in the generating vessel I, and is decomposed. The acetylene produced flows into the gas-holder L, which is balanced in the usual way so that the gas is pressed into the purifier M, and passes from this into the distributing-pipes under any pressure required.

In the position of the holder shown on the drawing, the maximum production of acetylene is supposed to be lit; the worm D being rotated at such a speed that it delivers the quantity of carbide required for generating the volume of gas consumed. When more gas is produced than is required, the bell L and the end of the lever R connected to it rise; and in consequence the other limb of the lever connected to the shaft S pushes the latter downwards. As the shaft slides in a bevel-wheel, the driving of the latter by the shaft is not interrupted thereby; but a friction pulley is brought nearer to the centre of a face-plate, so that the speed of the shaft, bevel-wheels, and worm D is reduced. The quantity of carbide delivered into the water in the unit of time is thereby reduced; and in consequence the holder will remain in the position in which the rotary speed of the conveyor D and the quantity of carbide delivered into the water exactly corresponds to the consumption of the gas required. If the quantity of carbide supplied is too great and the gas-bell L rises again, the friction pulley is further shifted towards the centre of the face-plate, and the speed of the conveyor further reduced.

APPLICATIONS FOR LETTERS PATENT.

22,818.—Hooker, G. S., "Gas-engines." Oct. 31.
22,826.—Bailey, J. W., and Clapham, J., "Generating acetylene." Oct. 31.
22,839.—Brünler, O., "Improvements in burners." Oct. 31.
22,890.—Henry, F. M., "Gas-lamps for incandescent lighting, and burners therefor." Oct. 31.
22,901.—Martini, A., "Automatic gas-igniting apparatus." Oct. 31.
22,920.—Hindle, N., "Gas-burners." Nov. 1.
22,922.—Smith, J. E., "Generation and storage of acetylene gas." Nov. 1.
22,945.—Eames, F. W., and Speaight, W. T., "Oil or gas engine." Nov. 1.
22,982.—Acres, B., "Apparatus for temporarily increasing the pressure of illuminating gas." Nov. 1.
23,001.—Goodson, J., "Draught screen for gas-burners." Nov. 1.
23,003.—Baurwebaerts, E., "Incandescent gas-burners." Nov. 1.
23,008.—Morris, L., "Generators and lamps for acetylene." Nov. 2.
23,037.—Preston, C. W., "Gas economizer." Nov. 2.
23,169.—Moss, R. J., and Timmins, S. A., "Acetylene gas-lamps." Nov. 4.
23,230.—Gilmer, G. A., "Generating acetylene gas." Nov. 4.
23,255.—Bormann, J. G. L., "Gas-producers." Nov. 4.
23,287.—Patterson, W. E., "Generators for acetylene gas." Nov. 5.
23,308.—Levetus, E. L., "Acetylene generators." Nov. 5.
23,316.—Gaebert, C. F., "Adjusting-taps for gas-burners." Nov. 5.

Water Supply Damaged by a Landslip.—At the mountain village of Hartley, near Kirkby Stephen, a serious landslip occurred last Thursday, choking up the stream from which the water supply for the village was drawn.

The Gainsborough District Council and the Gas-Works.—At the meeting of the Gainsborough District Council on Monday last week, they went into Committee to consider whether the time had not arrived for taking steps to purchase the gas-works.

Additional Capital for the York Gas Company.—At an extraordinary meeting of the York Gas Company held last Thursday, authority was given for the raising of £20,000, in £10 shares, carrying a maximum dividend of 4 per cent. per annum; being part of the £80,000 additional share capital sanctioned by the Act of last session.

The Public Lighting of Halesowen.—The Gas Committee of the Halesowen District Council yesterday week passed a resolution agreeing to accept the offer of the Gas Company to light the ordinary gas-lamps during the present season for £3 each, and next season for £2 15s., and £8 for each double incandescent lamp. This definitely settles the long-pending dispute.

The Gas, Electric Lighting, and Water Undertakings of the Wallasey District Council.—A statement of the receipts and expenditure of the Wallasey Urban District Council for the year ended the 31st of March last has just been issued by Mr. J. J. Burnley, the Accountant to the Council. On the gas lighting account, the income was £41,855, with an expenditure of £36,852; there being thus a credit balance of £5003. The income on the electric lighting account was £2141, and the expenditure £1402; leaving a credit balance of £739. The water-works accounts showed an income of £17,275, and an expenditure of £14,003; so that there was a credit balance of £3272.

The Derwent Water Schemes.—At the meeting of the Chapel-en-le-Frith District Council yesterday week, some further light was thrown upon the proceedings of the Provisional Committee of the Derbyshire District Councils on the proposed Derwent water schemes. The Clerk (Mr. Boycott) reported that the Committee had interviewed the Clerk to the Derbyshire County Council, and also the Town Clerk of Leicester; and after fully discussing the various schemes for utilizing the water from the Rivers Derwent and Ashop, the Committee unanimously came to the conclusion that, owing to the enormous cost involved, and for other reasons, a comprehensive scheme promoted jointly by the Corporations of Derby and Leicester would be far preferable to a separate scheme for one of the Authorities concerned. According to Mr. Boycott, the Town Clerk of Leicester had, in the course of conversation, stated that his Corporation were quite willing to co-operate with Derby in promoting a joint scheme, and for the various District Councils to be provided for in that scheme.

CORRESPONDENCE.

[We are not responsible for the opinions expressed by correspondents.]

The Benevolent Fund of The Gas Institute.

SIR,—The value of this fund has become very apparent during the past two or three weeks. I desire to urge that it be utilized by giving such relief as the circumstances call for.

The policy of the Committee of the fund is, in my opinion, open to much objection. Their aim seems to be to accumulate money, and invest it, until the interest arising therefrom amounts to such a sum as will meet all claims for assistance. A year or two ago the Committee were appealing for more subscriptions, "to enable them to deal adequately with the cases brought under their notice;" while at the same time they were seeking an investment for £230 they had by them. We may imagine them listening to the tales of woe with their eyes full of sympathetic tears, but keeping their hands tightly closed on the two hundred sovereigns they had for investment. Why should such a fund be accumulated? The Committee have no legal liabilities to meet. It is not like a life assurance society; there are no policies to fall in. If there is a surplus one year, it should be carried to the next, and work in the same way as a gasholder does, taking up the surplus at one period to give it out when larger demands arise. The investments in the eyes of the Committee are sacred, and must not be touched. True charity would not, however, hesitate to use any of the funds, whether invested or not, should pressing circumstances call for it. The money is subscribed to be distributed at once to any in need of relief. There is no necessity to provide for posterity; that would be to deprive our successors of their privileges. Those who follow us will be quite as able, and quite as willing, to help the unfortunate as we are now.

The formation of a large fund is calculated to give growth to evils. The fact of there being such a fund will be regarded by some thriftless ones as doing away with any necessity on their part to make provision for those dependent upon them. Also the knowledge of its existence will be apt to beget attempts on the part of the designing and crafty to obtain some of it for their own use. It is an inducement to imposition.

The love of money is said to be the root of all evil. Stagnant money has a corrupting influence. As much as will meet the necessities of the time, is all that is desirable with this fund. Many donors in times past have left money for the good of mankind, which has in the course of years festered, and bred evil.

I may point to the fact that, though The Gas Institute numbers some 700 members, there are less than 90 subscribers to the Benevolent Fund—plainly showing that the policy of the Committee does not meet with the approval of the general body.

"TOBIAS CANIS."

Nov. 12, 1898.

Developments in the Commercial Uses of Gas as a Fuel.

SIR,—My attention was attracted by a paragraph under the above heading in your issue for the 1st inst., having special reference to the use of gas in cloth-singeing machines. I do not know whether my experience in this matter is similar to that of others, but I must confess it has been rather disappointing. One of our consumers had one of these machines fitted up about a year ago. It has a full width of 8 feet, with six rows of bunsen burners controlled by separate stopcocks, so that it can be adjusted to any width of cloth. It required a supply to give not less than 1800 cubic feet per hour during the day; and I was told it would be worth half-a-dozen gas-engines. Of course, those visions suggested in your paragraph—1800 cubic feet per hour, 10 hours per day, and 313 days per annum—loomed up before me, and made me set about the work of laying a 3-inch main and fixing a 300-light meter with all enthusiasm. But alas for my bright hopes! This machine singes all the finer cloths—about half the total production of two factories employing 800 looms; but the speed referred to in the paragraph is so much greater than that of manufacture, that a few hours now and again suffice for the whole work. The consumption for the first ten months' working has only been 100,000, not 4,000,000 cubic feet.

Of course, an extra 120,000 cubic feet per annum is not to be despised in a small town; and gas managers should try, by all means, to get their staple product into every available field. But if anyone should indulge very sanguine hopes from the introduction of such machines as those in question, I fear he will be doomed to disappointment.

J. WHIMSTER.

Armagh, Nov. 8, 1898.

Tramway Traction.

SIR,—As a member of the Birmingham deputation who visited the Continent on the subject of tramways, and also a member of the Sub-Committee of inquiry appointed by the Public Works Committee of this city, I have read your special article and Mr. Hersey's letter, with a great deal of interest. I have also read Mr. J. Allen Baker's report to the London County Council.

I think there has been a misconception of the views of my colleagues and myself in relation to the adaptability of gas for tramway traction. Although we looked upon the Blackpool installation, in its then form, as scarcely suitable for such a city as Birmingham, we felt that the principle was capable of very great improvement and development. We shall continue to watch the progress of the system with considerable interest; for if a self-contained motor tramcar is ultimately forthcoming, which will be efficient, economical, and unobjectionable in its working, there are most important reasons why the question of its adoption should receive favourable consideration from all municipal authorities.

HOWARD LANE.

Birmingham, Nov. 7, 1898.

SIR,—I have much pleasure in supporting the opinions of the authors of the letters in your last two issues with regard to the adaptability and efficiency of gas-motors for tramway purposes.

The Neath Corporation lately purchased the horse tramways from a Company who had been in existence for many years, but had allowed everything to go to rack and ruin. The question then arose as to which was the best system to adopt. Of course, the universal shout was electricity, but the Borough Engineer and myself were instructed to furnish a joint report. After making an exhaustive inquiry, we came to the conclusion that gas-motor cars (though the Borough Engineer was very much in love with electricity) were the most suitable for us, both as regards efficiency and cheapness, over all other systems—taking the cost of gas at 3s. 2d. per 1000 cubic feet, which is our charge to consumers.

In company with our Committee, we visited Blackpool, and inspected the system there; and after due consideration, they unanimously went in for gas, especially taking into consideration the fact that the Corporation own the gas undertaking. The cost of the installation was in our case much lower and simpler than in others. Gas-motors will improve the same as other motors. Our cars are fitted with double cylinders, which will reduce the vibration to a minimum.

In conclusion, I can only add that I have every confidence in the gas-motor system; and my only object in troubling you with this letter is to "buck up" the gas profession, and show the electricians that we can tackle them in all quarters. The cars will be running in this town in February, when I shall be pleased to give anyone practical details.

ROBERT ALEX. BROWNING.

Neath, Nov. 11, 1898.

The Coal and Coke Problem.

SIR,—The dealing with, or handling of, material in gas-works, more especially in the form of coal and coke, I need hardly state to readers of the "JOURNAL" is one of the most important problems of the day, as affecting the economical production of coal gas. This arises from the well-known fact that the material, from the time of the delivery of the coal on the works, is handled three, four, or even six times—according to the description of plant used and the size of the works—before the coke leaves in buyers' carts; and the handling of 200 tons of coal is, in effect, the dealing with 800 or 1000 tons.

The inclined system of retorts, with coal-elevating machinery, appears to have solved the question, where it is in successful operation, up to a certain point. For once elevated, the coal gravitates into the retort (with occasional eccentric variations, no doubt duly appreciated by those in charge), and falls, as coke, from the retort. But so far I am not aware of the coke gravitating into carts, railway trucks, and barges, without a second handling by coke-elevators and conveyors. This second handling of coke is, to my mind, most undesirable, especially when the coke is of a soft description—a condition much appreciated for domestic use—and so does not require more breaking. For myself, I have no desire to see coke submitted to a process of clawing and hauling by machinery. There is enough breeze, without further scrunching up.

What is the remedy then? Simply this: Go up higher with the retort-house, elevate the coal an additional 10 or 12 feet, and abolish coke elevators, cellars, and subways below the yard level. It is, of course, a matter of opinion. It is far from my wish to dictate to others who know their conditions of working better than I do. The conditions at Barry are, however, most favourable to the scheme; one of the most important being that of a ready sale of coke for domestic use. Suitable hoppers for containing measured quantities of coke would be carried by girders, and would form the coke-floor. The matter is principally one of details; but the suggestion may prove of interest to others.

F. M. HARRIS.

Barry, Glam., Nov. 11, 1898.

LEGAL INTELLIGENCE.

HIGH COURT OF JUSTICE—CHANCERY DIVISION.

Wednesday, Nov. 9.

(*Before Mr. Justice* ROMER.)

Hayes v. The New Incandescent Gas Company.

This was an action brought to enforce specific performance of an agreement by the defendant Company to sell to the plaintiff the De Mare English patents for gas-burners.

Mr. FLETCHER MOULTON, Q.C., Mr. LEVETT, Q.C., and Mr. WALTER appeared for the plaintiff; Mr. NEVILLE, Q.C., Mr. RUFUS ISAACS, Q.C., and Mr. G. F. HART represented the defendants.

Mr. MOULTON, in opening the case, stated that the plaintiff, Mr. Hayes, acting on behalf of Messrs. Kern and Robinson—two American gentlemen who had patents for gas-burners in connection with incandescent lighting—negotiated with defendants, to whom the De Mare patents for England had been assigned by the Liquidator of the De Mare Company in France, for the purchase of those patents. The reason for so doing was that when application was made in Germany for a patent for the Kern burner, the De Mare English patents were set up in opposition to it; and it was thought advisable therefore to purchase these patents, simply as a protection to their own. A Mr. Tiano was employed to negotiate the purchase, and several interviews took place between him and Mr. Duncan, the Manager of the defendant Company; and various letters passed, leading up to the two constituting the agreement—an offer on Nov. 29, 1897, and its acceptance, subject to certain points, which were agreed to on Dec. 3. In the course of the negotiations, defendants, by their Managing Director, insisted that they would not put themselves in the power of any rival Company, and that they must therefore have a licence to work the patents if they desired; and it was agreed that they should have an exclusive licence to work one claim, which was termed the "collodion process," and a free licence to use the other patent.

The learned Counsel was about to read the letters, when

Mr. NEVILLE said they were not admitted at present. They probably would be, later on; but he objected to their being read unless his friend said he would call Mr. Tiano.

Mr. MOULTON said the two letters on which the agreement was founded were admitted on the pleadings; but he would call Mr. Tiano. The letter of Nov. 29 was from Mr. Tiano to Mr. Duncan, and said that he was desired by his principal, Mr. Hayes, to accept defendants' offer and purchase from them the De Mare patents Nos. 10,497 and 10,606 of 1894, on the terms mentioned—viz., to purchase outright all rights in the above

named patents; and granting to the Sunlight Company a licence to use the above if they desired to do so for their own use. And it was agreed that the Sunlight Company should have exclusive use of the third claim in the patent No. 10,606 of 1894. Then it set out the wording of the claim, which related to the making of collodion threads; the purchase price to be £750 and £100 commission. He enclosed £100 as deposit, and undertook to prepare an assignment to be accepted on or before Dec. 21, at which date he undertook to pay the balance of the purchase-money. In answer, Mr. Duncan, writing from Paris, said he had forwarded it to London with a recommendation that it be accepted formally by the Secretary. The formal answer came on the 3rd of December. It enclosed a letter from Messrs. Michael Abrahams and Sons, relating to the title to the patent, which it was suggested introduced a new term, but which, he submitted, involved no new term at all; and even if it did, the parties showed by their action that they accepted it. Plaintiffs' Solicitors then prepared a draft assignment, which was sent to the defendants; who made some amendments and returned it. The draft, as amended, was engrossed in duplicate, and executed by the plaintiff, and he believed was sealed by the defendant Company; but they refused to carry it out, and hence the present action. The defence was that there had been misrepresentation; but this he must leave his friend to make out. Messrs. Kern and Robinson had now sold the Kern patent to the Welsbach Company, who naturally did not want any patent which might interfere with it to be in the hands of a rival Company. It was not that the Welsbach Company wished to work the De Mare patents, or that there was any obligation on Kern and Robinson to enable them to do so.

Mr. *W. M. Robinson*, of Paris, said he was associated with Mr. Ottmar Kern in the Kern burner patents. In the year 1897, he was negotiating the sale of the patents to Mr. Julius Moeller, whom he at first supposed to be a private gentleman in London, but afterwards ascertained that he was the General Manager of the Welsbach Incandescent Company. He gave him an option on the patents. At the beginning of the negotiation, he knew nothing of the De Mare patents; but finding they were set up in opposition to the granting of the German patent, Mr. Kern suggested that the patents should be purchased, and he applied to Mr. Moeller for advice on the matter. Mr. Moeller suggested employing Colonel Hayes; and he told him to let Hayes go ahead and secure the patents. He was supposed to own all the Continental De Mare patents, and had a transfer of the French patent. Mr. Kern and he still held the Kern patents for other countries except England.

In cross-examination, witness said he gave Mr. Moeller the option on the Kern patents in May, 1897. His option was exercised in March, 1898. He arranged to buy the De Mare patents for the protection of the Kern patents. He left the matter entirely in Mr. Moeller's hands; and he did not know how Mr. Tiano came into it. He did not find the £100 which was sent to Mr. Duncan as deposit, but had paid it since. An account was sent by Mr. Moeller to Mr. Kern, who told witness to pay it. This account included the £100. That occurred after the issue of the writ in this action. He first heard about the action last spring, and was finding the money for it; but he had not paid anything yet. It was understood that he would find the money.

Mr. *John Bransbury*, Managing Clerk to Messrs. Saxelby, plaintiff's Solicitors, said they were instructed in the matter on Dec. 4 last. He prepared the assignment, which was sent to the defendants for approval, returned with alterations, and engrossed in duplicate as amended. It was executed by the plaintiff; and he left it with defendants' Solicitors for execution on Dec. 16. He subsequently tendered £750, the balance of the purchase-money, which was refused.

Cross-examined: He saw Colonel Hayes several times. He did not know he was acting for Mr. Moeller, or that there was anyone behind him. He was a retired Surgeon-Colonel in the English Army.

Mr. LEVETT said this was the plaintiff's case.

Mr. NEVILLE claimed to have Mr. Tiano put in the box.

After some discussion, this was done; but no question was asked by plaintiff's Counsel.

In cross-examination by Mr. NEVILLE, witness said he was originally interested in the Company who fought the De Mare patent action, when it was held to be an infringement of the Welsbach patents. Mr. Frederick Williams, a Director of the Welsbach Company, came to him and asked him to secure the English De Mare patents. He considered that he was acting for Colonel Hayes and two Americans. Their names were not mentioned in the first instance. He ascertained them about November, 1897, after he had been in communication with Mr. Duncan. Mr. Williams told him that they wanted to buy a lot of gas patents to launch a company in the United States. Witness drew this conclusion from what Mr. Williams said. He never stated that the De Mare patents were wanted to protect the Kern patents. Witness did not hear anything of these patents until long afterwards. He first saw Mr. Duncan on Nov. 10, 1897; and on the next day he said his Board would no doubt be inclined to sell the De Mare patents, subject to retaining the collodion process, if they were satisfied they were not going to be used by a rival Company. He did not think the De Mare patents were worth anything, because they lost the case in England, and soon after went into liquidation in France. He said the purchaser would be willing to leave the vendors the collodion process; that was in accordance with his instructions. Mr. Duncan said they could not run the risk of having a competitor outbidding them with their own tools. Witness's answer was that the patents were worth nothing, and that he was buying for an American gentleman who was getting together all the patents he could, and he thought it was for the purpose of launching a company. The representations he made were quite sincere, as he did not believe anyone could work the De Mare patents in England. He did not remember saying on Nov. 22 that he knew for certain that an American company was being formed. He said he thought the purchaser would lose his money, the same as he had, both in England and France. He did not remember Mr. Duncan asking him if he was sure there was nothing behind. He paid the £100 deposit on instructions of Mr. Williams, acting for Colonel Hayes. He drew his own cheque for the £100; but he received a cheque on the same day from Mr. Williams for £250. He thought, but was not sure, that it was a cheque drawn by Colonel Hayes.

Mr. NEVILLE then addressed the Court on behalf of the defendants, and submitted, on the authority of several cases, that specific performance ought not to be decreed where the vendor had been deceived as to the dentity of the purchaser, and when his interests would be adversely affected by the property passing into the hands of the concealed principal. It was evident these patents were being acquired in the interests of the Welsbach Company; and if Mr. Duncan and his Company had known that, they would not have entertained the proposition for a moment.

Mr. *J. H. H. Duncan*, Chairman of the defendant Company, said he first met Mr. Tiano in connection with the litigation between the Welsbach and the De Mare Companies; his own Company having also been in litigation with the Welsbach Company at the same time. On Nov. 10, 1897, Mr. Tiano came to him and said he had sold the Continental De Mare patents, and he thought he could find him a purchaser for the English patents. He asked what interest anyone could have in buying them. His Company had bought them for a special purpose—to be enabled to use one particular claim. Tiano said this right would be reserved to them. He told him repeatedly, at that and other interviews, that he could on no account enter into negotiations which would mean these patents being used in competition with them. He had no idea they were being bought on behalf of the Welsbach Company. Tiano gave him the most distinct assurances that the patents would not be used in opposition to his Company, and that they were being bought by an American who was getting together a lot of patents, and going to form a big company.

The case was then adjourned; and the Court has not since sat, on account of the indisposition of Mr. Justice Romer.

HIGH COURT OF JUSTICE—QUEEN'S BENCH DIVISION.

Monday, Nov. 7.

(*Before Justices* RIDLEY *and* PHILLIMORE.)

Mayor and Corporation of Liverpool v. Assessment Committee of the Llanfyllin Union and Overseers of the Parish of Llanwddyn.

This was a case stated by the Court of Quarter Sessions of the County of Montgomery in relation to the rating of the water undertaking of the Liverpool Corporation. The Court had delivered judgment on July 8 (*ante*, p. 160) in favour of the appellants, but had not entered into the figures. It was expected that the parties would be able to agree on the figures; but this had not been done, and it was necessary to apply to the Court.

Mr. HONORATUS LLOYD (Mr. BALFOUR BROWNE, Q.C., with him) represented the appellants; Mr. F. MARSHALL, Q.C., and Mr. ELLIS J. GRIFFITH, M.P., appeared for the respondents.

Mr. LLOYD said the respondents, the rating authority, desired now to put the rateable value of Lake Vyrnwy lower because part of it was not situate within the parish of Llanwddyn. This was an entirely new point; and in his view the Justices at Quarter Session had treated the whole lake as being in the parish, because the dam was wholly within it. The real object of the respondents in their contention apparently was that they might win on the appeal in the other parish, where the rest of the lake was situate.

Mr. MARSHALL contested this, and urged that a proportion of the whole value of the property should be allotted to each parish according to the acreage within such parish.

The COURT expressed the opinion that the point was necessarily implied in the decision of the Court, and that it was not, therefore, a new question raised at the last moment. It was clearly right that the rate should be levied in respect of the property really situated in the parish. The result would be that there would be a deduction in value for the part of the lake situate outside the parish of Llanwddyn. The gross value was therefore £12,037, and the rateable value £9630.

The Winding Up of the Ystrad Gas and Water Company.

It may be remembered that, under the terms of the award of the Umpire (Sir F. Bramwell) in the Ystrad arbitration, the sum of £231,364 was to be paid by the Ystradyfodwg District Council for the Gas and Water Company's undertaking. The Act giving the Council the necessary power to purchase contained directions as to the application of the purchase-money. In the first place, all mortgages were to be paid off with interest; then the debts and liabilities of the Company were to be discharged; and the residue was to be divided rateably among the stock and shareholders in proportion to their interests in the profits. A question arose on the last point as to whether the shareholders should first receive their capital in full, and then divide the remainder, or whether they should divide the whole surplus. The matter recently came before Mr. Justice North in the Chancery Division of the High Court of Justice; and his Lordship decided that the entire surplus should be divided.

A Question of Liability.

In the Queen's Bench Division of the High Court of Justice last Tuesday, the case of *Knight v. Perry and Co.* came before the Lord Chief Justice and Mr. Justice Wills, sitting as a Divisional Court, by way of appeal from the decision of the County Court Judge at Bow. The plaintiff was in the employ of Messrs. Christie and Co., gas-fitters, and was sent by them to do some fitting in Farringdon Market. While working in the shop of a tenant named Hampton, his attention was called to an escape of gas, which was put right by another workman. Hampton then suggested that the cock should be turned off at the meter; and this the plaintiff did. He then held a candle above his head to see if it was turned off, and an explosion occurred, which resulted in injury. The plaintiff alleged negligence in respect that the defendants had left in the roof an unplugged pipe which caused an escape of gas into the chamber. The County Court Judge nonsuited the plaintiff; holding that there was no evidence of negligence to go to the Jury. The Court dismissed the appeal, with costs; the Lord Chief Justice saying that the plaintiff was not in the employment of Messrs. Perry and Co., and therefore did not come within the first section of the Employers' Liability Act, which provided for a right of action by an employee against his master, and that, in his opinion, there was no evidence of contributory negligence.

MISCELLANEOUS NEWS.

FATAL GAS POISONING CASE AT PLYMOUTH.

An accident of a somewhat singular character occurred last Tuesday night at the Duke of Cornwall Hotel, Plymouth, and resulted in the death of a youth named George Lee, who was employed as a page boy, and the narrow escape of another employee, named John Brittain, from the same fate. About midnight, a kitchen porter named May was going to bed, when he found that gas was escaping from a bracket on the top landing of the hotel. He called the attention of George Finch, the night porter, to it. Finch struck a match and applied the light to the base of the bracket, with the result that a jet 4 or 5 inches long was lighted. This he put out, and plugged the hole with soap, tying a handkerchief round it, and then testing it again with a match. Everything was apparently safe; and Finch returned to his ordinary duties. At six o'clock in the morning, he went to call Lee and Brittain, who slept together in a room divided by a lath-and-plaster wall from the passage in which the bracket is situated; the bracket being secured to this wall. As there was no answer to his knocking, he burst open the door, and found both lying unconscious—Lee across the foot of the bed, and Brittain on the floor under the window. Medical assistance was called, and Brittain, after twenty minutes' unremitting attention, regained consciousness; but Lee was dead. Examination of the room showed that a considerable quantity of plaster had fallen from the wall immediately behind the place where the escape was discovered; and it was evident that there was an explosion—probably at the moment when the porter applied the match to the escaping gas. Another circumstance noticed was that the gas in the room was lit when Finch entered it at six o'clock in the morning.

The inquest on the body of Lee was held on Thursday by Mr. J. GRAVES, the Deputy-Coroner. The Gas Company were represented by Mr. ERIC WARD, Solicitor, Mr. J. THOMAS, the Secretary, and Mr. A. WHARTON, the Manager.

Finch and *May* were the principal witnesses as to the circumstances attending the escape, and the efforts to stop it, and both agreed that there was no report as of an explosion, and no noise of falling plaster, when the escaping gas was lighted. There was nothing to indicate that gas was escaping otherwise than into the passage. Finch added that he did not notice a smell of gas when he entered the bedroom at six o'clock. It was a large and lofty room, but there was no fireplace in it.

Mr. *H. H. Parsloe*, a surgeon, said the death of Lee was due to asphyxia the result of coal gas poisoning.

Brittain, who had regained consciousness, knew practically nothing about it, but thought he got up and lit the gas at five in the morning.

A JURYMAN remarked that it did not seem probable that the gas could have been burning without causing an explosion.

Mr. WHARTON said that would depend upon the extent of the leakage. There apparently was an explosion which blew the plaster off the wall; but it must have been very slight, as it did not blow out the window.

In answer to Mr. WARD, Mr. *Parsloe* said it was possible for there to be a sufficient quantity of gas in a room to asphyxiate a man without causing an explosion. A man might recover even after inhaling gas for forty hours.

A JURYMAN asked if there was anything in the character of the gas now supplied in Plymouth—a mixture of water gas and coal gas—which would be more fatal than ordinary gas.

Mr. *Wharton* was called to give evidence on this point. He said that the day supply of gas in Plymouth was a mixture of coal gas and water gas; the latter being present in the proportion of 30 per cent. Water gas was not manufactured or turned into the mains between 10 p.m. and 6 a.m. As the winter advanced, it would be supplied day and night; but at present the demand did not necessitate it, and as a matter of economical working they did not run the plant at night. Water gas contained 30 per cent. of carbon monoxide, a poisonous gas which entered into the composition of coal gas, but was present in larger quantity in water gas. He knew that there was an agitation against the use of water gas in the North of England; but he did not think it would come to anything.

The CORONER: But should it come to anything, is there any great danger to the public?

Witness: No.

By the JURY: An admixture of water gas and coal gas was more likely to prove fatal in case of an escape than coal gas alone; but there was no greater risk of explosion.

The CORONER: Is the danger of gas poisoning increased in proportion to the quantity of water gas—in this case 30 per cent.?

Witness: No; but I really have not studied the question. It would need to be gone into very carefully, and you would have to take into consideration the proportion of the mixture in the atmosphere.

A JURYMAN remarked that, as water gas was not being supplied at the time the deceased met with his death, these questions did not affect the present case.

The verdict was one of "Accidental death;" and the Jury, in a rider, acknowledged the efforts of the doctor to save the life of the deceased.

THE FINANCIAL POSITION OF THE HINCKLEY GAS UNDERTAKING.

At a recent meeting of the Hinckley Urban District Council, a long discussion took place upon the position of the gas undertaking. The matter had been investigated by the Gas Committee; and a statement was submitted showing the financial condition of the Gas Department during the five years ending March 31 last. It was stated, however, that the accounts had been kept in such a way that it was impossible to get a correct presentment of capital and revenue, as no separate account had been kept of various items of expenditure. There appears to have been a loss of £278 in 1894, and of £1244 in 1895; but in 1896-7-8 the profit was put down at £416, £621, and £11. The total loss being £1522, deduction of the profit (£1048) made the loss £474 on the five years. At the close of the year 1893 the balance of profit and loss account was £2337; at the present time it is £1863—showing £474 less than five years ago. The above figures were all taken from the ledger; but in 1894 the gas-rental account was shown £99 too much, and in 1895 £427 too much. This was corrected in the accounts for the year ending March 31 last. In conjunction with the foregoing statement, the Gas Committee issued another giving the sums placed to the sinking fund in the five years. They were: In 1894, £474; in 1895, £992; in 1896, £545; in 1897, £543; and in 1898, £559. The Committee said: "In the year ending March, 1895, the sum of £425 was written off as bad debts or allowance; and in the same year the gas-rents for the March quarter were entered at the gross amount, and no allowance was made for discounts. Had this item been correct in the years 1894 and 1895, the loss in these two years would have been shown £526 more, and the profit for the year 1898 would have been shown at £550. Since the works were purchased by the Council in 1881, the total profits are shown as £5742, and deducting losses amounting to £2079, leaves a balance of £3663 on profit and loss account, out of which £1800 was transferred to the district rate in 1884 and 1888."

The Chairman of the Committee (Mr. Abbott) said there was nothing left for him to explain. As most of the Council were aware, the sum of £1800 had been taken from the Gas Department by the old Local Board. Mr. Smith said they knew all about £1000; but where did the £800 go? Mr. Abbott did not reply; but on being pressed, he said he was not prepared to answer the question. Continuing, he said that, after deducting the £1800, there was a clear profit left amounting to £1863. This ought to have been a valuable help for them; but from the statement got out by Mr. Lee (the Manager) it would seem that while they were making a profit year by year, they appeared to get into a worse position at the bank. It seemed beyond his comprehension—he did not profess to have the cleverest head—but he thought that, with a clear profit of £1863, they ought to have been able to pay all accounts up to date. But this was not so. If they had been able to pay them as they fell due, they would have saved interest. Mr. Bott inquired whether the Manager was satisfied with the balance-sheet. The Chairman (Mr. G. Kinton) said he was, with the exception of one or two of the items. Mr. Bott asked what was the profit on last year's working. The Chairman replied that he believed it was approximately £700; but Mr. Lee had put it down at £11. He (the Chairman) understood Mr. Lee considered the profit to have been about £550. Mr. Bott remarked that there was a great difference between £550 and £11; and so there must be something wrong somewhere. He wished to know if the Council would appoint a small Committee, composed of members of the Gas Committee and the Council, to examine the books, so that they could understand their position more clearly. This course would be fair both to the late and the present Manager; but it would not be fair to either to go on discussing the matter unless some further light could be thrown upon it. Mr. Aucott said, in reference to the £1800, there was no question that £1000 was "stolen" from the gas-works. With regard to the £11 profit put down for last year, no doubt £400 or £500 had been spent on different things which ought to have been paid for out of revenue. When they had a nice balance, £1000 was taken and another £800 four years afterwards. If the money had been left, the Council would have been able to pay 10 per cent. profit. This was what started the dilemma; and until they could do something by means of a loan, they would get into a terrible mess. Mr. Wells said it was useless to cry over spilt milk; the only thing left for them to do was to be more careful in the future. Mr. Smith said that when the Local Board purchased the gas-works in 1881, they cost £32,000. To-day their capital was £33,198. Let them look at their turnover for last year—£9000—out of which they had to pay interest and provide for the sinking fund. He did not care who the man was, after these two items had been met he could not make any profit if he had to pay for coal, labour, and so on. And they were now going to spend £12,000 more. The Manager said no doubt at £45,000 the works were heavily capitalized; but the moment they got their new gas-works, they would be able to reduce the cost per 1000 cubic feet. If they could increase their customers by 500, to use 40 or 60 million cubic feet of gas a year, the works would not be so burdened with capital. It was his firm conviction that when the new works were finished they would pay their way. He attributed the loss in a measure to no sinking fund payment being made for one year. Mr. Bott's proposal for a Committee was negatived by 11 votes to 3; and the subject then dropped.

Since the above was in type, a long explanatory letter by the former Manager (Mr. G. Helps) has appeared in a local paper. Dealing first with the statement as to the way in which the accounts had been kept, he characterizes it as incorrect. He says the "Cheques Authorized" book at the gas-works, signed by the Chairman of the Gas Committee when the accounts were presented, showed in detail the proportion of each account to be charged to revenue or to capital. Coming to the question of the loss on the undertaking, Mr. Helps says: "In 1894 and 1895, losses were shown in the accounts presented to the Gas Committee by me (although no loss was actually incurred in these particular years), which were the accumulations of unpaid accounts anterior to the commencement of my management. In my report to the Gas Committee dated March, 1894, I refer to the loss; and in 1895 I prepared myself a statement of revenue which was supplied to each member of the Gas Committee, and therein is set out exactly how the loss of £1244 was accounted for—viz., £1837 6s. 4d. charged to this year belonged to previous years; so that there was a profit made on the year's working of £593 6s. 4d. (£1837 6s. 4d., less £1244), though a loss was shown. The profits shown for 1896 and 1897 are correct; but that for 1898—£11—is most decidedly wrong. There was a profit made in 1898 amounting to about £600. This was after paying £500 for house extensions and alterations; and it would be interesting to know how this amount has been reduced to £11." As to the statements that at the close of the year 1893 the balance of profit and loss account was put at £2337, whereas at the present time it is £1863—showing £474 less than five years ago, and that in 1894 the gas-rental account was shown £99 too much, and in 1895 £427 too much, Mr. Helps says they are most misleading; for though the figures may have been "taken from the ledger," they could not have been found there until the ledger had been made up in accordance with "new ideas," and its arrangement so altered that a sum of something over £500 had been set against his last year (March 31, 1898), lowering his profit, which, under the system adopted by the

Clerk and Auditor for the past eighteen years, should have gone to reduce the profit of the current year. He characterizes all the statements made by the Committee as "grossly misleading and inaccurate." He charges the Committee with endeavouring to "deal with detail questions of accounts without knowing or caring to know the details." His reply to the statement that £474 was lost in the five years from 1894 to 1898 is that, far from such loss having been incurred, a profit of £1952 was made, after paying interest, sinking funds, &c., and, in addition, spending considerable sums out of revenue in improvements at the works—a result which, he says, "has not been equalled in any ten years of previous management." With regard to capital, in March, 1893, it was £35,720, or it would have stood at this figure if the sinking fund had been regularly paid; being equal to £1047 per million cubic feet of gas made. The capital of the undertaking in March, 1898, was approximately £35,000 (including £1000 for new land, from which no benefit had accrued to the undertaking), or equal to £700 per million cubic feet. The capital per million cubic feet of gas made was therefore reduced in Mr. Helps's time by no less than £347. The gas sold in 1893 was 28,941,600 cubic feet; in 1898 it was 42,000,000 cubic feet—an increase of 45 per cent. With regard to charging repairs to capital instead of to revenue, Mr. Helps shows that in the five years from 1889 to 1893 only £1853 was spent on repairs and maintenance, as compared with £5582 laid out in the succeeding five years under his management; and he says, with respect to the works, that such was their state that the Gas Committee by special resolution relieved him of the responsibility for a regular supply of gas until they were put into proper condition, to do which he had to spend considerable sums—the revenue bearing its full share of the responsibilities. Summing up, Mr. Helps says that during the five years he had the honour of serving the Council, the Gas Department flourished more than it had ever done before.

ACETYLENE GAS LIGHTING AT COWDENBEATH.

Consumers Dissatisfied.

In our "Notes from Scotland" last week, reference was made to the dissatisfaction manifested by the consumers of acetylene gas at Cowdenbeath, as shown by an article in the "Dunfermline Journal." It may be of interest to reproduce the article in question, though, as already pointed out by our Scottish Correspondent, discontent does not necessarily mean failure of the system:—

So far, the installation of acetylene gas has not proved the success it was expected to be. Apart from the high price of carbide of calcium, from which the illuminant is generated, the regular supply of the article cannot be relied upon; and the storage-tanks have occasionally been run empty at rather awkward hours. The matter has been receiving the serious attention of the Directors of the Cowdenbeath Gas Company, Limited, and arrangements have been made by which a fortnight's trial is to be given of an experiment of mixing the acetylene gas with oil gas, which was until recently the illuminant. Meantime, the accounts have been sent out to consumers, who are indignant at the large sums which are being charged them as compared with what they had to pay under the old order of things. It is principally shopkeepers who have got beyond the stage of burning paraffin oil; and a number of them are in open revolt against the high rate, which is a serious charge upon their business. The price per 1000 cubic feet of oil gas was 12s. 6d., while for the acetylene gas—of which, of course, there is much less consumption—it is £5, or, as those concerned in the Gas Company put it, 10s. per 100 cubic feet. So serious do some of the shopkeepers regard the situation, that a public meeting was held in one of the committee-rooms of the Co-operative Hall on Tuesday, the 1st inst., for the purpose of considering if any action should be taken to remedy matters. Mr. Smith, draper, was called to the chair. In the course of his remarks, the Chairman spoke of the supply being irregular and of poor quality lately, and also giving off a large quantity of sooty matter, which destroyed goods such as millinery. The price, too, he said, was a serious consideration—from 12s. 6d. to 15s. 6d. a week for gas being rather a heavy item of expense in a business. They were too near Dunfermline, he thought, to be handicapped in this way much longer. Mr. Dundas pointed out that no one was bound to use the gas though he had a supply at hand; but he observed that the Directors had told them that the acetylene gas would be no dearer than the oil gas, and that probably it would be cheaper. From communications he had had, he was led to understand that the charge should not be more than 4s. per 100 cubic feet, and that in some cases it could be supplied at from 3s. 4d. to 3s. 10d. The charge of 10s. was out of the question; and he thought they ought to appeal against it. There was no purifier, and the gas was not good. At Kirkliston, to which he had paid a visit, a draper was manufacturing the gas for his own private use at a cost of ½d. per burner per hour, while in Cowdenbeath they were paying about 1d. He understood that the Cowdenbeath Burgh Commissioners had a contract with the Gas Company to supply gas for the lighting of the streets at so much per lamp; and, as far as he could learn, no more was being paid for the new gas than for the oil gas. The other consumers must therefore be paying for the deficiency in the revenue thus caused. Mr. Strachan said that, so far as he was concerned, the new gas had involved a considerable loss not only by the increased cost, but by the damage which had been caused. He was not prepared to suggest a remedy; but if it came to a question of testing the legality of the payment, he would be prepared to bear his share of the expense. Mr. Dundas stated that two other consumers, who could not be present, were also willing to contribute their share, as they thought the matter should be placed in the hands of an agent. The Chairman remarked that the price was quite prohibitive. Mr. Miller endorsed what the previous speakers had said; and he thought that an appeal should be made against the charge, which was exorbitant in view of the quality of the gas. He had goods wasted, besides being put to trouble by the light going out. Mr. Strachan said he understood the Gas Company were losing, even at the rate they were charging. A general discussion followed, in which it was pointed out that the Directors had held out that the acetylene gas would be cheaper and better than the oil gas, and that one burner would be as good as two. One gentleman remarked that the gas was being mixed now, and this evoked the retort that matters were being made worse. Some shopkeepers, it seems, have gone to the expense of putting up new fittings, which will practically only be of use for acetylene gas. The oil gas, with which the pipes had apparently been charged, had been driven before the acetylene gas. It was alleged that the pipes were underneath the pavement, and that a great leakage was taking place. A suggestion was made to the effect that legal advice should be sought; but ultimately it was unanimously agreed to appoint a Committee to wait upon the Directors of the Gas Company, and state the grievances of the consumers. In conversation with a gentleman interested in the Gas Company, one of our representatives was told that a number of consumers could very much reduce their gas bills, as their premises are overlighted. The new gas, he alleges, has a high penetrating power, and very few jets of gas are required to light a building. There is a feeling, which was voiced at the meeting, that the Burgh Commissioners should undertake the whole lighting of the burgh; and this question may be discussed at a future meeting.

The Cowdenbeath Police Commissioners, on Thursday night, received a report from their Roads, Streets, and Drainage Committee regarding the price which the Gas Company are charging for the supply of acetylene gas to the public lamps—10s. per 100 cubic feet. Provost Mungall stated that if this figure were to be continued, the Commissioners would require to find some other method of lighting the town. The supply, too, was uncertain, because of the difficulty the Gas Company had in procuring calcium carbide; the result being that the streets had been in darkness for two or three nights. The Committee were of opinion that, provided the Gas Company did not move in the matter, the Commissioners should consider the three schemes of (1) acquiring the present gas-works, and supplying coal and oil gas; (2) erecting new coal-gas works; or (3) introducing an electric light installation. The subject has been left in the hands of the Committee, for negotiation with the Gas Company and the procuring of further information. A *plébiscite* on the question of whether the Commissioners should or should not take over the lighting of the burgh, was spoken of.

SALES OF STOCKS AND SHARES.

Last Tuesday, Mr. Alfred Richards sold at the Mart, Tokenhouse Yard, stocks and shares in several Gas and Water Companies. The first parcels offered consisted of consolidated "A" and "B" stocks of the Croydon Gas Company, which were sold at the rates of £300, £277 10s., and £270 per £100 of stock; the first-named price yielding the purchaser £4 13s. 4d. per cent., and the average of the two last (£273 5s. 2d.) returning £4 0s. 6d. per cent. Some ordinary £10 shares (£6 paid), bearing a dividend of 9 per cent. per annum, were purchased for £15 apiece; returning £3 12s. per cent. A number of £10 shares in the Lowestoft Water and Gas Company, on which 5¼ per cent. per annum is being paid, were disposed of at prices ranging from £14 15s. down to £14 each. Some consolidated stock of the Brentford Gas Company, the last dividend on which was at the rate of 12 per cent. per annum, was sold at £277 per £100 of stock; yielding £4 6s. 8d. per cent. on the investment. A parcel of £10 ordinary "E" shares in the Aldershot Gas and Water Company was sold at an average price of £16 7s. 8d. per share; yielding £4 5s. 5d. per cent. Some £10 fully paid original shares in the Grays Gas Company, Limited (last dividend 8 per cent. per annum), fetched £18s. 10s. apiece; bringing the purchaser £4 6s. 6d. per cent. on his investment. A few "B" shares, of similar nominal value, were purchased at £13 10s. each; yielding £4 2s. 11d. per cent.

Among other sales last week, the following may be noted: Some original £10 shares in the Altrincham Gas Company fetched an average of £23 8s. 9d. each. A few £5 original shares in the Princes Risborough Gas Company realized from £3 14s. to £3 16s. each. Some new ordinary £10 shares in the Yarmouth Water Company, bearing 7 per cent. interest, fetched from £12 10s. to £13 per share; the aggregate amount realized being £1986 5s. Last Thursday, Messrs. Alexander, Daniel, and Co. sold by auction £15,000 of Bristol Water-Works 7 per cent. maximum consolidated ordinary stock. The reserve price was £154 per £100 stock. The highest price realized was £155⅞, and the lowest £154½; the average being slightly over £154⅝. The sale realized £23,199 12s. 6d.

Announcements which appear in another part of the "Journal" indicate that opportunities will shortly be afforded to investors to obtain, or increase existing, holdings in well-established gas undertakings. On the 6th prox., Mr. Alfred Richards will offer, at the Mart, Tokenhouse Yard, E.C., by order of the Directors of The Gaslight and Coke Company, £187,500 of the Company's ordinary stock, issued under the provisions of the Act obtained last session. It ranks for a standard dividend of 4 per cent., subject to the sliding-scale; and, in view of the last distribution on the "A" ordinary stock already issued, it would be entitled to receive a dividend at the rate of £4 18s. per cent. To-morrow week, Mr. Richards will offer £15,000 of new stock, 1881, of the Brentford Gas Company (similar stock now earning 9 per cent.); and on the 29th inst., he will put up for competition a new issue of £13,500 of 5 per cent. stock of the Southend Gas Company. An important sale will take place on the 13th prox., when Messrs. Branch and Leete will offer £40,000 of new 7 per cent. stock of the Liverpool United Gas Company, created under the powers of their Act of 1886. On the 5th prox., Mr. M. Stainton will sell by auction £8000 of new stock of the South Shields Gas Company.

ELECTRIC LIGHTING NOTES.

Regarding the electric lighting scheme for Bury St. Edmunds, the Town Council (like many others before them) have failed to turn the will of the Local Government Board. The original project has had to be dropped; and last Tuesday a modified one was adopted, which it is estimated will cost £16,000.

For about three hours on Thursday evening the greater portion of Tunbridge Wells was plunged in darkness, owing to the failure of the electric light. Business was greatly impeded; and as many of the tradespeople resorted to candles for illuminating purposes, the chief shops presented a

quaint appearance. It is reported that the failure was due to the fact that number of consumers' wires were defective, and this threw an extra load on the transformers.

The Leeds Corporation, at their meeting last week, approved of the proposed agreement for the purchase of the Yorkshire House-to-House Electricity Company's undertaking. It was stated that by it the Corporation would take over the concern as from Sept. 1, so far as capital expenditure was concerned, and as from Oct. 1 in respect of revenue. Stores, &c., would be taken at a valuation. The purchase-money would be paid in stock, bearing interest at 5 per cent.; and the Corporation would take the whole staff and their agreements.

The Lighting Committee of the Wolverhampton Town Council appear to be very satisfied with the progress their electric lighting undertaking is making. Speaking at the meeting of the Council last Wednesday, Alderman Mander stated that in 1895, they had 7236 lamps; while now the number was 16,718. In addition, there were 1409 lamps on order; so that by Christmas they would have more than 18,000 lamps. Before the report of the Committee was adopted, it was suggested by Alderman Marston that it would be sound policy for the Council to buy the gas-works.

We agree with the "Yorkshire Post"—and many of our readers will probably hold the same opinion—that "electricity cannot yet be trusted for public lighting." In Manchester on Wednesday evening there were two breakdowns of the electric system affecting 27 miles of cable, and the first could not be remedied for an hour. This, occurring on the edge of dusk, affected the shops and a meeting of the City Council; the other, at ten o'clock, caused a good deal of inconvenience in places of entertainment. The town of Woking was in almost complete darkness for two nights last week, owing to the failure of the electric light.

The Rathmines and Rathgar Town Commissioners have applied for a loan of £50,000 for lighting the district by electricity; and Mr. C. P. Cotton, the Chief Engineer and Inspector of the Local Government Board for Ireland, held the usual inquiry on Monday last week. The Commissioners have had the question under consideration for a long period; having consulted Mr. Robert Hammond as far back as 1895. They obtained a Provisional Order in 1896; but until now they have done little in the matter. In describing the scheme to the Inspector, Mr. Hammond is reported to have said that the total estimate was £25,000; and he calculated that "the other small general expenses" would make the total of £50,000.

An interesting experiment is being made at St. Helens. It takes the form of an effort to place the working of the tramway system under the joint proprietorship of the Corporation and private enterprise. The Corporation will generate and supply the electric power; while the Company (to whom the Corporation have granted a lease of 21 years) will provide the vehicles and working staff. On their side, the Corporation undertake to lay down rails of the most improved type, to equip the lines on the trolley system, and to supply electric energy at 2d. per unit for the first 400,000 units—reducible to 1d. per unit when the full quantity of power is consumed. The Corporation also provide capital for the permanent works at a moderate rate of interest; while the Company work the traffic, and have a free hand in developing their business.

A singular occurrence was recently experienced at High Wycombe, in connection with the electric lighting of the town. At midnight a kind of explosion occurred in the mains. Simultaneously the glass globes of several of the street-lamps, and in many of the private houses where the light was turned on, were shattered; while others fell off in consequence of the fusing of the juncture with the wires. At the same time the alarm bells in some of the firemen's houses and at the police station were set ringing, and firemen, policemen, and civilians were soon running about to see where the supposed fire was. Fear was allayed by the discovery that the central fire-call had not been interfered with. It is supposed that the cause of the occurrence was that the mains were overcharged, and the escaping current affected the wires leading to the fire-call. The supply was very much interfered with.

The provision of an electric lighting installation has been agreed upon by the Durham City Council; and they will at once take steps to obtain a Provisional Order for the purpose. The Council have been advised in the matter by Mr. W. A. Hawtayne. His report shows that he is of opinion that the wisest course would be to erect plant of a total capacity of 350 kilowatts in the first instance; and he recommends the low-tension short-wire system as the most likely to suit. The total cost of plant of a capacity of 200 kilowatts he estimates at £17,350; and for 350 kilowatts, £2000 additional. He calculates that the gross revenue will be £2956, at a charge of 5½d. per Board of Trade unit, which is "equivalent to gas at 2s. 9d. per 1000 feet." Taking the working cost at £1767, leaves a gross profit of £1189. If the larger plant is installed he working expenses will be £1820; and the net profit, £112.

On Saturday, the 5th inst., the streets, shops, and sea-front promenade at Llandudno were illuminated for the first time by the electric light; the current being switched on by the Chairman of the District Council (Mr. T. T. Marks). The event is specially interesting from the fact that Mr. Marks is a member of The Gas Institute, and is upon the Benevolent Fund Committee. He was for some time Manager of the gas-works, and is now Chairman of the Gas and Water Committees of the Council. The works, which he opened on the above-named day, have been designed by Mr. A. H. Preece, and are situated just outside the railway station. The plant consists of three Babcock and Wilcox boilers, two of which will be fired from destructors, while the third will be hand-fed with coal or coke. The engine-room is equipped with two 100-kilowatt steam dynamos and one of 50-kilowatt power, together with a motor generator for regulation and for charging the batteries. The two principal generating sets are each capable of giving an output of 100 kilowatts at 440 to 500 volts. For the street lighting there are altogether 48 arc lamps, erected on cast-iron pillars. The lamps along the promenade, 30 in number, as well as those at important crossings, are fixed in carriers protected from the weather by a canopy—an ornamental as well as useful appendage. The remaining 18 lamps are all fixed along the kerb at the side of the road, suspended from overhanging brackets. The lamps on the sea-front are fixed about 50 yards apart; those in the town at a slightly greater distance.

There seems to be strong reason for the complaints that are being made, both inside and outside the Leamington Town Council, as to the illuminating power of the electric light furnished by the Midland Electric Light Company. Things have come to such a pass that the Corporation Watch Committee have instructed the Town Clerk to write to the Company on the matter. This was reported at last Wednesday's meeting of the Council, when various members related their experiences. Mr. Fell stated that, on the previous Sunday, with two lights on in a room 16 ft. by 12 ft., he had to have a lamp to see to read. He pointed out that the Corporation had put stringent conditions on the Gas Company with regard to the candle power of the gas they supplied; and he thought they should impose the same conditions on the Electric Light Company. He did not want to return to gas; but he certainly would go back to candles if the electric light was to continue as it had been during the past few months. Alderman Bright declared that not only was the light bad at times; but it occasionally went out altogether. During the previous month, the Committees had more than once or twice been entirely deprived of light. It was intolerable that the present state of things could be allowed to go on any longer. Mr. Molesworth, on behalf of some of the outside users of electricity, joined in the protest against the way the current was being supplied. Mr. Purser gave instances in which the electric light had collapsed within the past month; and Alderman Wackrill asserted that they never knew when they could depend upon the current at all. To his own knowledge quite recently one of the principal shops in the town was obliged to close its doors because there was no light; and, being in the jewellery trade it was considered much better and safer that the shop should be closed than left at the mercy of anybody. It was stated that a letter had already been addressed to the Company by the Town Clerk; and it is hoped that this and the protests of the councillors will bring forth an explanation and an improved illuminating power.

METROPOLITAN WATER SUPPLY COMMISSION.

Thirty-second Day—Monday, Nov. 7.

(*Viscount* Llandaff, Chairman, *Sir* John E. Dorington, Bart., M.P., *Sir* G. B. Bruce, M.Inst.C.E., *Major-General* A. de Courcy Scott, R E. *Right Hon.* J. W. Mellor, Q.C., M.P., *Mr.* A. de Bock Porter, C.B. and *Mr.* R. Lewis.)

This was the first sitting since the Commission adjourned on July 25; and it was held at the Guildhall, Westminster.

The following are the Counsel engaged: Mr. Pope, Q.C., and Mr. Claude Baggallay, Q.C., for the New River Company; Mr. Littler, Q.C., and Mr. Lewis Coward for the Kent Water Company; Mr. Pember, Q.C., for the Lambeth, East London, Grand Junction, and West Middlesex Water Companies; Mr. Rickards for the Chelsea Water Company; Lord R. Cecil for the Hertfordshire County Council; Sir Joseph Leese, Q.C., M.P., for the Kent County Council and Kent Local Authorities; Mr. Balfour Browne, Q.C., and Mr. Freeman, Q.C., for the London County Council; Sir R. Nicholson for the Middlesex County Council; and Mr. Gabriel P. Goldney (Remembrancer) for the Corporation of the City of London. The Southwark and Vauxhall Water Company are represented by Messrs. Bircham and Co.

The Chairman said he presumed Counsel were aware that the Commission proposed to deal first with a separate and small subject—namely, that of inter-communication between the different Companies. The President of the Local Government Board had written asking them to take such evidence, and report upon it as soon as possible.

Mr. Pope said since the communication from the Commission to the Companies that this would probably be the course taken that morning, the Companies had met and carefully considered what their position should be with regard to it. They were prepared to offer general evidence as to the practicability of such a matter; but it involved so many small considerations of detail, and the general legal bearings of the question, that it appeared to them desirable to save the time of the Commission by directing their evidence, if called on, rather to the general question than to going into a long inquiry in detail as to any particular scheme of connection. The Companies had further concluded that it would be a convenience, and therefore (as a convenience) they would undertake the duty of promoting in the next session of Parliament a Bill obviating this question of detail. For instance, without legislation the Companies could not be relieved of their statutory obligation to supply except for the purposes of their own district, and especially of those particular obligations which bound individual Companies not to supply water to adjoining Companies. These things would have to be dealt with by legislation. He was instructed, on the part of the associated Companies, to call attention to a series of resolutions which they came to, and which in general terms expressed their views in regard to such legislation. Their view briefly was that, while a scheme of inter-communication was perfectly practicable, it would be desirable that some authority should be armed with power to say how and in what way the connection should be made—not merely when the emergency arose, but in anticipation of a necessity. They would suggest that the matter might be left in detail to the Local Government Board—putting upon the Companies an obligation to carry out whatever decision the Local Government Board might come to.

The Chairman stated that the Commission were asked to advise by whom, and in what proportion, the cost of making the connections should be borne, and what were the legal powers necessary to give effect to any such arrangement. He did not see therefore that the Commission could avoid making suggestions to the Local Government Board.

Mr. Pope said all these questions had been considered by the Companies' representatives. He proceeded to read the following memorandum which was handed in:—

The Companies propose to introduce a Bill in the next session of Parliament, for the purpose of providing for, and facilitating, inter-communication between the mains and works of the respective Companies, and the supply when needed of available or surplus water, so as to avoid the risk of deficiency in times of unusual drought or accident. The Bill to contain *inter alia* provisions to the following effect: (1) The Companies forthwith to consider what works are required for the above objects, and to submit proposals to the Local Government Board for approval. The Local Government Board to be empowered to approve and authorize such works with or without modifications, or to authorize and order other works for the like objects. (2) Further works for the above objects may in like manner be

from time to time authorized and ordered if, and when, required. (3) The respective Companies to carry out in their respective districts all works so authorized. (4) The Local Government Board to be empowered to authorize the supply of surplus water from the works of any Company to the works of any other Company for the time being requiring the same; and the Local Government Board to have power, in case of emergency, to authorize any of the Companies to take more water from the Thames than they are now authorized to take. (5) All expenditure of the respective Companies in relation to any such works to be deemed capital expenditure; and for the purpose of meeting such expenditure the Local Government Board to be empowered from time to time to authorize the respective Companies to issue an additional amount of debenture stock. (6) No contribution to any sinking fund to be made in respect of capital issued for the foregoing objects. (7) Subject to reasonable contribution by any Company taking and utilizing by means of the proposed works and powers water which they would not otherwise have been enabled to take and utilize, the interest on debenture stock applied by the respective Companies for the foregoing works to be borne by the eight Companies, in proportion to their respective water-rentals. (8) Any Company taking water from another Company to pay for such water to the Company supplying it, at a rate to be agreed upon or fixed by arbitration. (9) A standing Arbitrator to be appointed by the eight Companies, or failing such appointment by the Local Government Board; and in case the respective Companies do not agree among themselves such Arbitrator at the end of each year to decide as to the contribution of either Company taking and utilizing the water rendered available by the proposed works, and also to decide any matters in difference between the Companies

The CHAIRMAN: I think the President of the Local Government Board would expect some criticism of these proposals.

Mr. POPE: No doubt. We were anxious to assist the Commission in this part of the inquiry; and therefore we have put our collective views before the Commission to assist them.

The CHAIRMAN: I understand the eight Companies concur.

Mr. POPE: Yes.

Mr. LITTLER said the position of the Kent Company was somewhat different from that of the other Companies; but, in general outline, they were at one. There might be matters of detail to which he would have to call attention.

Mr. BALFOUR BROWNE understood the Commission would at some time return to the question of purchase.

The CHAIRMAN: Oh, yes.

Mr. BALFOUR BROWNE said the County Council thought the scheme might become absolutely unnecessary if the Commission should take the view that purchase by a public authority was the right course to take.

The CHAIRMAN thought the Local Government Board were of opinion that immediate legislation was expedient, whether purchase were resolved on or not. He believed the Local Government Board intended next session to introduce legislation. Possibly they might adopt the proposal of the Bill to be introduced by the Companies.

Mr. *Ernest Collins*, Distributing Engineer to the New River Company, was then called and examined by the CHAIRMAN. He considered it quite practicable, from an engineering point of view, to connect all the systems of supply of the different Companies. The connections must be limited to a certain extent in accordance with the quantity of water there was to pass from one Company to another. He thought there were no reasons of convenience or expense, or engineering considerations, which would make it more desirable to limit the connections to some of the Companies only. The supplies of all the Companies could be made interchangeable.

Mr. DE BOCK PORTER: Would you say some of them have no available surplus to dispose of?

Witness: Oh, yes. At the time of the greatest supply, hardly any of the Companies have any to spare.

The CHAIRMAN: Then what is the use of inter-communication, if none of them could supply any water to their neighbours?

Witness replied that this was the difficulty the Engineers of the Companies had to consider when drawing up the scheme contained in their report dated Oct. 18, 1897, on the proposals to make interchangeable connections between the mains of the several Companies.

This report, which gave details of twenty connections between the various Companies, was handed in. The Engineers found that the only Company who had practically any surplus at times of great pressure was the Chelsea, who had powers to draw from 8 to 10 million gallons daily from the Thames more than they were utilizing in their district. The connections in this scheme were laid out with a view to transferring from one point to another a quantity of water not exceeding 10 million gallons a day.

The CHAIRMAN: Do you mean that all the Companies between them, at a time of pressure, would be short of water for their own purposes?

Witness: Not for their own purposes, but to spare.

That seems to strike at the desirability of inter-communication?—It does.

There is no use for inter-communication if there is nothing to communicate?—Precisely.

Mr. POPE said that had reference to October, 1897. Since then the Southwark and Vauxhall Company had obtained further powers, which allowed them to assist the East London Company.

Witness (continuing) said the Southwark Company had a surplus now of about 10 million gallons a day, which was not available when the report containing the scheme was drawn up. This made a surplus of about 20 million gallons. The scheme was devised to meet a temporary breakdown—the fracture of a main or failure of a pumping-engine—rather than failure in the source. The Southwark and Vauxhall Company's surplus was not likely to be absorbed by increase of consumption in their area. The Southwark Company were in a peculiar position. They had been erecting new works at Hampton, with a view to dismantling their works at Battersea; and this had enabled them to give a good deal of assistance in the present year to the East London Company, which, if the works were dismantled, would not be available.

The CHAIRMAN: I understood Mr. Pope to suggest that they had power to draw extra water?

Witness: They have power of drawing an extra quantity of water, but not power, I believe, of inter-sale among the other Companies.

Mr. POPE: No; it is absolutely prohibited.

Witness went on to say that the West Middlesex, Grand Junction, and New River Companies had, during the temporary difficulties of the East London Company, supplied them with between 8 and 9 million gallons daily, of which the New River Company provided 6 millions. From the Kent Company, they had about ½ million gallons daily; and from the Southwark and Vauxhall Company he understood they were receiving about 6 million gallons more daily—about 14½ million gallons in all. He did not agree that the scheme suggested was the best mode of dealing with the question. The experience of the past year modified the proposal, and pointed to the efficiency of the seven Companies in carrying out their duties to the public. Assistance was only required by one Company. It was questionable—not only in his mind but in the minds also of the other Engineers—whether the scheme was absolutely necessary as regarded the seven Companies. Even if the connections were made, he did not believe—ignoring the East London Company—they would be required. Certainly they would not be by the New River Company, whose engines, mains, &c., were duplicated and triplicated in some places. Each Company was quite capable of taking care of itself. The outlay for this scheme would be £307,867. There was a second scheme, and one which was better than that contained in the report; but he was not authorized to put it forward as having the approval of the Boards of Directors in any way. The first plan was the best for temporary purposes; but it was practically only wanted for one Company; and the needs of that Company could only be supplied by two—the Southwark and Vauxhall Company and the Chelsea Company—unless the other Companies extended their works. The Chelsea Company had command of 8 or 10 million gallons, but not the means of bringing it. The £307,000 included pumping-engines, filters, and new mains which the Chelsea Company would have to lay to transfer the 10 million gallons to another Company. The suggestion was that the water should be passed from Molesey to Putney Heath, and that a main should be laid thence across the Thames to Campden Hill. This temporary scheme would not be sufficient for a case like that of last autumn; but it would meet a breakdown of machinery or mains.

The CHAIRMAN: What is the use of a scheme of inter-communication that will not meet such an emergency as that of last autumn?

Witness: I think in case of duplication for a breakdown it is useful; but each Company must look after itself to a certain extent. No doubt the East London Company are going to erect more works for their own purposes; then this, as a stand-by in case of sudden emergency, would no doubt be useful.

Mr. DE BOCK PORTER: Do you advocate this expenditure as being desirable for a mutual insurance between the Companies?

Witness: It might be a sort of insurance for them. I do not think it is necessary, leaving the East London Company out of the question.

By Sir JOHN DORINGTON: The New River Company gave assistance to the East London Company without help from the West Middlesex and the Grand Junction Companies, at the worst time. It was not till October that the latter Companies came in. The connections now made between these three Companies might be further extended; but in order to make them effectual, the Grand Junction and West Middlesex Companies must provide more filter-beds and mains, so as to be able to give their water. When the mains were all interchangeable, some Companies would have to increase their works, so as to be able to put more water into their own mains. But he thought this might be carried too far; it might make the Companies less self-reliant. If they could rely on their neighbours, they might not be too anxious to spend money on their own account. Still, he did not believe any of them would look at it in that light.

Further examined by the CHAIRMAN: Upon existing powers, the Chelsea, Southwark and Vauxhall, New River, and Kent Companies had surplusses they could give their neighbours. The West Middlesex and the Grand Junction Companies would be in the same position if they had more filter-beds and further power to draw water; but this was not included in the estimate. Witness proceeded to detail another scheme of interchange. The Southwark and Vauxhall Company were constructing fresh works at Hampton which would be substituted for the present ones at Battersea, which it was intended to dismantle. At Battersea, there was a filtering plant sufficient to deal with 15 million gallons daily, and pumping power for 25 million gallons. The Company also had a main from Hampton to Battersea conveying unfiltered water. Under ordinary arrangements, these works would be dismantled; but it appeared to the Engineers, in discussing this matter, that as a temporary measure it might be possible to devise means of utilizing these Battersea works, at least until other arrangements were made. Supposing 10 million gallons were available there, the position would be very central for distribution, and mains could be laid in every direction for the assistance of all the Companies. The first main would be to Campden Hill of the Grand Junction Company, and be capable of delivering 10 million gallons per day. No. 2 main would be a junction between Campden Hill and the New River head at Islington, with a capacity of 6 to 7 million gallons daily; No. 3 would connect Battersea with the New River head, and have a capacity for 10 million gallons; No. 4 would run from Battersea to the Lambeth reservoirs at Brixton; and No. 5 would be from the Southwark and Vauxhall system at Nunhead to the East London Company, through the Tower Subway, with a capacity of 10 million gallons daily. Thus, providing the Southwark and Vauxhall Works at Battersea could be utilized, all the Companies could be coupled up. Assistance could thus be rendered not only to the East London Company, but all round. This scheme supposed the legalization of inter-sale. The total cost would be approximately £255,346 for mains and connections, beyond which the Battersea works would have to be purchased or rented. The scheme, which had received the approval of the other Engineers, would be the means of rendering available 10 million gallons of water a day from the Southwark and Vauxhall Company, 6 millions from the New River Company, and 3 millions each from the Grand Junction and West Middlesex Companies—a total of 22 million gallons.

The CHAIRMAN: It is a great pity you did not lay this scheme before us instead of the first one.

Mr. POPE: I am afraid that is because of the delicacy of the position. It has not been officially sanctioned by a meeting of the Engineers, nor by a meeting of the Chairmen of the respective Companies.

By Mr. MELLOR: The Battersea works were on land worth about £10,000 an acre, and there were 30 acres. Then the main from Hampton to Battersea would be worth about £150,000—together (say) £450,000. Three per cent. on this would give, perhaps, the rentable value. Rent might also have to be paid on the fixed machinery, and the machinery would have to be kept up.

Major-General Scott: You bring this forward as a temporary measure, do you not?

Witness: It would be so far permanent that the mains laid under the scheme would under any circumstances—if you did away with the Battersea works—be available to carry water from a central station.

You do not contemplate that the filter-beds at Battersea should remain permanently in use, do you?—I should not think so. Why we suggest this Battersea scheme is that it is immediately available.

Mr. Mellor: As I understand, supposing the Companies were purchased by any authority, these works would probably be kept up by the purchasers for the purposes of inter-communication between different parts of their system?

Witness: They would be very useful for the purpose—as a reserve. There should be a central reserve to take you all round London.

Mr. Pope: Battersea might be a central station for the distributing works; but these would be available whatever the distributing centre might be. That is what I understand.

The Chairman: Hardly so. How can the mains from Battersea help distribution from other centres?

Witness: In this way. If Battersea, with its filtration plant, were dispensed with, it would naturally be necessary to bring water from some other part of London to Battersea. Other works would have to be constructed, and Battersea would simply be a distributing centre. You might run a main from Battersea to Hampton. You might have your filtering plant at Hampton, and pump the filtered water direct into the Battersea centre, and so distribute it again among the various Companies. I cannot give any idea as to how the cost should be distributed among the Companies.

It would seem that the Companies who find the surplus water ought not in fairness to contribute as much, if at all, to the cost?—Of course, they would be paid for the water they sell. At present there were only certain of the Companies possessed of surplus water, and they did not want a scheme of inter-communication. Naturally these Companies felt it rather hard that they should be saddled with part of the expense, for the benefit of those who did require it. The only Company who wanted assistance at present was the East London. Even they, he thought, would probably get over their difficulties, and not want aid again.

Mr. Pember: The position of the East London Company to-day is not what it will be in a couple of years' time; and as these works are permanent, it would be rather hard that all the expense of them should be put upon the East London Company.

The Chairman: The result is that nobody wants these works, and that nobody should bear the cost of them.

Witness (continuing) said it would require eight months to carry out scheme No. 2—to lay the mains so as to make it workable. As the scheme would involve an Act of Parliament, it would be about eight months from the passing of the Act authorizing the scheme.

The Chairman: I am afraid that would carry you over the next dry season.

Mr. Mellor: I suppose we may take it that the Southwark and Vauxhall Company have assisted the East London without parliamentary powers?

Witness: Clearly, yes.

The Chairman: But that assistance has been much short of what you propose they should be able to give?

Witness: Yes.

How have they been able to do that? There are Acts forbidding them to sell their water.

Mr. Pope replied that they had disregarded their Act of Parliament. Necessity had compelled them to do so.

Sir *H. E. Knight*, Chairman of the Southwark and Vauxhall Company, said he did not agree that in assisting the East London Company his Company had done anything illegal or beyond their powers. The Company had sources of supply other than the Thames. The Thames water they could supply only to their own district; water from other sources they could treat as they liked. The advantage of No. 2 scheme was that it enabled the works of all the Companies to be joined up without in any way interfering with the ordinary distribution in their districts.

Cross-examined by Mr. Balfour Browne: He did not know the total quantity the Southwark and Vauxhall Company drew from the wells was 1½ million gallons only. Ignoring the East London Company, his opinion was that both schemes were superfluous; and as neither would assist his Company, he did not see the justice of being brought into the scheme and bearing part of the cost. He did not know that the Local Government Board had reported that the Battersea site was unsatisfactory. It might be advisable, if the scheme were adopted, for the Companies to have power to draw a little extra quantity from the Thames in case of emergency, subject to the approval of the Local Government Board; and they intended, he believed, to ask for this power. If the prohibition or limitation of sale of the Company's water were abolished, they would have sufficient water for a surplus of 22 million gallons daily to be distributed under scheme No. 2.

Cross-examined by Lord R. Cecil: The 6 million gallons which the New River Company had been supplying to the East London Company came partly from wells and partly from the Lea.

Lord R. Cecil asked the Chairman to direct the production of the gaugings of the Lea, which were exceedingly important from the Herts point of view, in order to show what water was left in the Lea—whether it was true, as the county alleged, that the pumping from the wells acted on the Lea and Chadwell springs.

The Chairman ruled, however, that this was not within the scope of the inquiry.

Mr. *J. W. Restler*, Engineer to the Southwark and Vauxhall Company, examined by the Chairman, said he considered the second scheme infinitely better than the first. The two were conceived with totally different objects. The first was mainly to provide a supply in case of temporary breakdown of mains or machinery. After the experience of this year, the Engineers thought it necessary to deal with the possibility of the recurrence of such circumstances; and with this object witness suggested the use of the Battersea works. The Company had power to retain these works if they thought fit. The financial basis of the arrangement was that the associated Companies should pay (say) 3 per cent. interest on £300,000—30 acres at £10,000 per acre—which would cover the use of the whole of the plant. The 15 million gallons which the Company proposed to set aside as the emergency supply would have to be filtered at Battersea. There was, however, a clause in the Company's Act of last year which would prevent them giving the whole of this quantity. If the quantity were wanted for any considerable time, the 30-inch main bringing unfiltered water from Hampton to Battersea would have to be duplicated, so that this might be left for the unfiltered supply to Battersea, while the Company could get the substituted portion of the 15 million gallons for the supply of their own district. This quantity would be available to meet unforeseen contingencies—say, the failure of wells in Kent or of the Lea. The supply would not absolve the East London Company from finding a way out of their difficulties for themselves. Such a price, he imagined, would be fixed on the Company requiring the supply as would practically amount to a penalty—thus making it bad policy for a Company to rely on such works as these. Among unforeseen contingencies, he should include such a drought as was experienced this autumn; but the drought having occurred, the Company suffering by it should provide for its recurrence. The cost of the scheme would be considerably more than that of the first. Arrangements were being made to join the mains of the Southwark and Vauxhall Company with those of the Chelsea Company, where they crossed in the Upper Richmond Road. As a matter of fact, nearly all the Companies had connections between their systems now.

Mr. De Bock Porter: Would it materially affect the financial arrangements of the Southwark and Vauxhall Company if the Battersea works, instead of being dismantled, were used in the way suggested?

Witness: No. In the Act of 1894, permitting the construction of the alternative works at Hampton, a clause was inserted that the capital authorized should be reduced by the amount realized from the sale of the Battersea works; so that if they were not sold, the whole of the capital authorized by that Act would be called up, with no set-off against it.

By Major-General Scott: The existing connections between the Companies would almost suffice to meet next year a drought such as occurred this autumn, if the East London Company commenced taking from that supply immediately they had to fall back on their reservoirs. This was assuming they could receive 6 million gallons from the New River Company, 3 to 5 millions from the West Middlesex and Grand Junction Companies, and 6 millions from the Southwark and Vauxhall Company.

Cross-examined by Mr. Balfour Browne: If his Company's district grew as it was growing, their surplus water would be required for their own use.

Mr. *W. B. Bryan*, Engineer to the East London Water Company, examined by the Chairman, said he agreed with the second scheme, the connections under which could be made by next summer if there were no legal difficulties. This, however, would be impossible if an Act were required. At present his Company were receiving from the Southwark and Vauxhall, Kent, New River, Grand Junction, and West Middlesex Companies about 13,200,000 gallons of water a day. The price paid the Southwark and Vauxhall Company was £15 per million gallons, and to the Kent Company, 6d. per 1000 gallons. The amount to be paid the other Companies was not yet settled. He could not answer questions as to what connections his Company would rely on next year, having only received notice that morning that this evidence would be required. He would, however, prepare it.

Mr. *John Hollams* said he represented the New River, the Chelsea, and the Kent Companies; but when the associated Companies acted together, he represented them all. Questioned as to the resolutions Mr. Pope had read, he said the view of the Companies was that, as legislation would be necessary, it was impossible to foreshadow any definite scheme of inter-communication. It must vary as population and consumption increased and as circumstances changed. The Companies therefore thought it better that any such scheme should be regulated from time to time to meet requirements, under the control of the Local Government Board.

The Chairman: Do I understand you that the Companies suggest an Act which should not authorize any particular set of works, but such works as the Companies hereafter may propose and the Local Government Board approve of?

Witness: Yes; or such as the Local Government Board may impose on the Companies.

That would be a novel form, would it not? It strikes me as an extraordinary novelty that works not described, not enumerated, not specified, but left to the discretion of the Companies and the Local Government Board between them, are to be authorized?—Yes; the circumstances do not admit of prescribing them.

Examination continued: All the extra power required was that the supply need not necessarily be restricted to their own districts. If the Companies were amalgamated, and given the same powers for the whole London area, they would have all the powers required. The power sought was really to remove the technical application of the Water-Works Clauses Act to a particular district, and make it available for other districts. Witness was taken at length through the resolutions. Under No. 4, the statutory prohibitions as to sale would remain, but the Local Government Board would have power in case of emergency to say they might be disregarded temporarily, and also to sanction more water in the same event being taken from the Thames. Two things must be considered in relation to the subject. They must have the water, and they must have the means of conveying it; neither without the other was of use in the present difficulty.

The Chairman: You know Parliament has watched rather jealously this right to take water from the Thames. It has limited the amount each Company may take. A Royal Commission has recommended an enormous increase in the storage of the different Companies, to enable them to get on without increasing the draft on the Thames. We have been told that there are but two Thames Companies who have a surplus. Yet here you make a proposal that the Local Government Board shall have power to authorize any Company to draw more water from the Thames, even in times of greatest drought—and the greatest want, therefore, of water in the river—in spite of all these precautions that Parliament and the Royal Commission have taken?

Witness: Only in an emergency which calls for some such thing. It is merely temporary. It is a case which no one anticipates, and which one hopes and expects will not occur. It is merely to meet the recent scare, and the repetition of any such disaster. As to the water taken from the Thames, if there were adequate storage the draft would be immaterial, because at times there is a superabundance of water, so that the depletion of the river is entirely dependent on the storage. The Companies have been asked to deal with this question; and they feel that if necessity arose they should have this power.

In reply to a suggestion from the Chairman, that this seeking of power to draw further water from the Thames indicated that the Companies did not think their present supplies sufficient, witness said that was not so. But if some of the Companies were to be overtaxed for the benefit of others, they did say it might be advisable to increase their possible draft on the Thames. The power was only to enable one Company to benefit its neighbour—not itself. With regard to the proposal that there was to be no contribution to the sinking fund in connection with this matter, witness said the only excuse for a sinking fund was that the money expended was assumed to yield revenue and profit. Here it was obvious there could be no profit, and therefore there could be no pretence for putting the sinking fund on such expenditure.

Thirty-third Day.—Tuesday, Nov. 8.

Mr. *Hollams*, in further examination by the Chairman, said the payment made by a Company receiving benefit under the resolutions would be in the nature of a way-leave, and would have relation to the quantity of water taken, the time during which it was taken, the distance conveyed, &c. Probably the contribution would not be very heavy, because the essence of the scheme was mutual protection of all the Companies. It must be borne in mind, also, that this insurance was against risk which did not concern the Companies, because they were protected from accident or drought. Witness was questioned closely as to what was to guide the arbitrator in fixing the contribution of a Company; but he declined to go beyond saying the "general circumstances." The fact that one Company alone had made use of the system would certainly not justify the Arbitrator in charging the whole interest on the outlay on one Company. If the inter-communication system was not used, each Company would contribute to its cost in proportion to their water-rental. If a Company required water, they would pay the Company supplying it; and he anticipated no practical difficulty in fixing the price. The charge would probably be lower than the ordinary price. This was the case at present with the East London Company who were paying a sum which yielded no profit to the supplying Company. The receiving Company supplied the water to their own consumers; but they could hardly be said to sell water to them, because they charged a rate, undertaking to supply water save only in case of drought, accident, or frost. It was a fallacy to say a Company sold water. The rate was levied on a house whether occupied for only one or twelve months in the year, and irrespective of the quantity consumed. In East London, he believed many houses were supplied at a substantial loss. The rich paid for the poor, no doubt. The objection to supplying by meter was on sanitary grounds. Replying to the suggestion that this difficulty could be met by starting the initial price at an amount amply sufficient for sanitary purposes, he said he could not argue the question; but he knew there were sanitary objections to that. He proceeded to refer to a circular issued by the Local Government Board in October, 1897, under which it appeared that they thought they had some of the powers which it was now proposed to give them. According to this, schemes were to be put forward for approval by the Local Government Board or the Railway Commissioners; and under the Public Health Act of 1875 power was given to the Local Government Board to sanction a local authority supplying water in an adjoining district.

Cross-examined by Mr. H. L. Cripps (in the absence of Counsel for the London County Council), witness said the present scheme would tend to lessen the value of the Companies' concerns, because it would involve an annual burden on themselves. If the only opposition to the Bill that would have to be promoted had for its object the insertion of a clause like clause 84 of the Staines Act of 1896 (which provided that the privileges granted by the Act would not, in case of purchase by a public authority, have to be brought back), he should advise that it should be accepted. The receiving of water under the inter-communication scheme would not benefit either the seller or the purchaser.

By the Chairman: The East London Company, being prevented by drought from giving a full and constant supply, were not violating their statutory obligations. The scheme suggested, if adopted, would merely enable the Companies to do something which they were not bound to do by statute. Therefore there was no occasion for such a clause as that suggested. The Companies were simply voluntarily taking on themselves a serious annual burden for the protection of the public against a risk which would not fall on the Companies. The short supply being excused by drought, the income of the Company would not be diminished at all; nor would a full supply aided by the inter-communication scheme increase their income.

Sir *H. E. Knight*, re-called and examined by the Chairman, said he considered the schemes of inter-communication practicable and desirable, though he was quite certain they would never be wanted or brought into use. The present condition of affairs was sufficient to meet another drought like the one just experienced. They had been altered since the drought by more connections having been made. It was true these connections had not yet enabled the East London Company to resume the constant supply; but this was because the assistance was not rendered as early this year as it would be next. Thus the Company would not have to draw on their reserves so early. The New River Company had been supplying 6 million gallons daily for weeks past, and had now made connections with the West Middlesex and Grand Junction Companies which enabled them to supply 3 millions more. Then there were connections with the Southwark and Vauxhall Company whereby they got another 6 million gallons. This made 15 million gallons daily available now or next year—ignoring the small quantity procurable from the Kent Company. This quantity could be augmented by a few works which could be carried out this autumn. If the connection between the East London and the Southwark and Vauxhall Companies was enlarged, the latter Company could give 10 instead of 6 million gallons. Other engineering works, however, would be necessary to enable this to be done. Then the Kent Company would be able to afford 2 million gallons more, which could be conveyed through the Southwark Company's main when a projected connection was completed. By a communication with the Chelsea Company, a further 3 million gallons would be available *via* the Southwark and Vauxhall Company's main. This gave 24 million gallons daily which the Companies, with their present powers, and without any trouble, could place at the disposal of the East London Company.

In reply to Major-General Scott, witness said he could guarantee the supply from his own Company for several years, because he had always endeavoured to keep his works in excess of requirements. The whole of the water from his Company could be treated at Hampton. The Battersea works would not be needed at all by them.

The Chairman: Your evidence suggests that the Battersea scheme is an unnecessary expense?

Witness: The Battersea scheme as laid before you is a necessary and admirable one, if we are to satisfy the public mind. As I said from the first, although it may be a very good insurance, it will seldom or never be wanted. The need is only with the East London Company at present; and their case could be met with an expenditure of no very serious importance—£25,000 or £30,000. To do this, no Act of Parliament will be necessary.

In reply to further questions, witness said the Companies had taken every precaution. This, he thought, was shown by what happened this year. The Companies had power to make agreements for the sale of water to anybody. He would not suggest that No. 1 scheme should be set aside. It was very admirable so far as it went, though No. 2 was better. It was a question whether the first would not suffice for all emergencies when the Companies were in the condition they ought to be in. With an expenditure of £25,000 or £30,000, they could meet another drought like the last. The failure was called a drought; but this was a wrong term, because when 25 gallons of water per head per day were supplied, they could not call it a famine. The difficulty was caused by the ridiculous system of building houses without cisterns; but for this, they would not have heard a word as to failure of supply in East London. If they had cisterns with shelving bottoms, like the side of an inverted champagne bottle, whatever sediment there was would flow out with the water. With the lids riveted tightly on, there would be practically no sediment. He held that each Company should be compelled to have sufficient appliances, not only to meet the actual maximum demands of their district, but to supply at least 3 million gallons more. Then the eight Companies would have 24 million gallons, which, if they were all coupled up, would be available for the use of anyone. Assuming his Company abandoned the Battersea works, their total filtering area would be 22 acres, to deal with 46 million gallons daily—when supplying the East London Company with 10 million gallons. But this would only be in time of emergency, and at a season when water was much more easily filtered than in the winter time. If the system of inter-communication were to be made efficient, they must get rid of the clauses prohibiting inter-sale of water from the Thames. All the water supplied to the East London Company by his Company had been from sources other than the Thames. The Southwark and Vauxhall Company were sinking wells now, and had more in prospective. Whichever scheme of inter-communication Parliament thought best, the Company were prepared to carry out. Either Parliament should give the Companies power to take more water in case of emergency, or the Local Government Board should be the authority to give permission under certain conditions. He thought it would be a proper measure for control of the Companies to require them to have works 3 million gallons daily in excess of their requirements. In the interests of all the Companies, they did not want a recurrence of the recent failure.

By Sir G. Bruce: By power to draw more water from the Thames, he meant even below the 200 million gallons flowing over Teddington Weir. If the drought had proved anything, it was that the reserve of this quantity over Teddington Weir was utterly useless and unnecessary. Less than this had flowed over the Weir, and no calamity had happened, beyond perhaps a barge or steamer going ashore. But what was this compared with the wants of London? As long as the Thames would supply water and London wanted it, the Companies should be able to take it. There should perhaps be a limit; but to make this limit 200 million gallons at Teddington, was to put it much too high. All the Companies were striving to place themselves in as secure a position as his Company occupied.

The Chairman: I see you have a suggestion for a kind of Central Committee, which should supervise the action of the Water Companies?

Witness: I am of opinion that a Committee formed of the representatives of the Water Companies would not be at all a bad thing. It might be formed of the Chairmen of the Companies, with the power which it was proposed to place in the hands of the Local Government Board. If the Committee thought one Company was not doing its duty, they should have power to order that Company to execute works to bring it level with the others. If it was necessary to go to Wales for a further supply, the Committee should be able to direct the Companies to go to Parliament for the purpose. The case of a recalcitrant Company would have to be met by giving the Committee power to take steps which would make their decisions respected.

Cross-examined by Mr. Freeman: The wording of the resolution would not necessarily mean that the amount paid by one Company for water should be simply the cost price. The figure was to be agreed or settled by arbitration. The price at present paid by the East London Company to his Company was the cost. Questioned as to whether the power to sell water in this way would not increase the price to be paid for the Company in case of purchase, he said the selling of water at cost would not increase the Company's profit. If the Lambeth Company were drawing 32 million gallons, whereas they had power to take only 24 million gallons from the Thames, they were drawing beyond their powers or must apply to another Company. It might occur that witness's Company might be supplying this excess to the Lambeth Company, who would be distributing it in a part of their district which was part also of the Southwark and Vauxhall Company's district; so that the latter Company would be taking water from the Thames and handing it to the Lambeth Company who would supply it at higher rates than the Southwark and Vauxhall Company

could supply it in the same district. This might be the case during short periods of emergency. He did not think his idea of a Supervising Committee would be practical amalgamation. It would be confederation; amalgamation he regarded as almost impossible. It would not be confederation without restriction, to avoid amalgamation with reduction of rates.

In reply to the CHAIRMAN: Besides the rates, there were other difficulties in amalgamation—such as parliamentary powers and obligations, &c. If confederation were adopted, leaving each Company to work out its own ends, they would avoid all these difficulties.

Mr. *Walter Hunter*, Engineering Director to the Grand Junction Water-Works Company, and Joint Engineer to the Staines Reservoirs Committee, examined by the CHAIRMAN, said No. 2 scheme of connection appeared to him to be better than No. 1. It was not really much more expensive; and it had the advantage of joining the works of the Companies without in any way interfering with internal distribution. He confirmed the preceding witness by saying he thought it probable that the existing communications of the East London Company, somewhat enlarged and improved, would amply suffice to meet the possible breakdown of that Company. This would be much cheaper than one of the larger schemes; but the Companies had felt they were open to a good deal of criticism from the public in regard to the fact that they had not been able yet to render that assistance one to the other which the public thought they had a right to expect. They were very anxious to do anything necessary to ensure the supply of any district of the Metropolis. If the whole question were looked into before the Commission, and if the Commissioners could come to a certain resolution, this might satisfy the public mind as any statement given by the Companies alone could not possibly do. No doubt an enlargement and improvement of the existing mains and communications of the East London Company, as proposed by Sir Henry Knight, would make that Company safe for next year, because they were only under a temporary disability due to a failure of the Lea in consequence of an unprecedented drought. With the works they now proposed, no doubt they would soon be in as good a position as any Company in London—but not within the next year. This was the difficulty they were endeavouring to meet. Both Sir Henry Knight's improvement of existing connections and scheme No. 2 could be completed by next summer, if the Companies had such an assurance given them as would justify them in putting the works in hand at once. If the Commission were satisfied as to the necessity of the works, and would report in that sense to the Local Government Board, the Government might introduce a Bill giving the necessary powers. The No. 2 scheme would enable filtered water, ready for delivery, to be handed from almost any one Company to any other Company. This would be useful and desirable whether purchase took place or not. The same mains would be useful for the same purpose. It would therefore not be a waste of money, in the event of purchase taking place in a reasonable time, because it would guard against any possible breakdown. As to the cost, he agreed about the sufficiency of the £255,000 for the mains and connections. He understood the Southwark and Vauxhall Company were willing to allow the associated Companies the use of their Battersea works, and of part of the 36-inch main from Hampton, at a rent. If the rent of the works were taken at £9000 a year, this would be £45,000 for five years. The third of the Campden Hill works of the Grand Junction Company would cost £1200 a year, or £6000 for five years. The rent of the main would be roughly £1800 a year, or £9000 for five years. These items made a total of £315,000, which would be the cost of No. 2 scheme for five years. This would include nothing for standing charges. From Battersea, it was proposed to pump into reservoirs at Campden Hill, Claremont Square, the New River Head, and Brixton. The great advantage of the scheme was that the water would be delivered into the various reservoirs whence the distribution would go on in the ordinary way without any interference. There would be no difficulty with regard to pressures or levels or similar things either way.

By Major-General SCOTT: The Southwark and Vauxhall Water Company would ultimately want a portion of the 15 million gallons, so that it would only be available for this purpose for a limited time. Part only of the 36-inch main would be available for the scheme, because the Southwark and Vauxhall Company would want part sufficient for 5 million gallons. The communications between the East London and Southwark and Vauxhall Companies worked very well as from the former to the latter, because the high reservoir at Nunhead was supplying. He could not say how the arrangement would work if reversed. In scheme 2, the Grand Junction and West Middlesex Companies were supposed to pass 3 million gallons daily to the New River Company. With existing plant and powers, the Grand Junction Company would only be able to deliver to this scheme 1½ million gallons daily. To enable the Company to deliver more, they would require a main from Kew Bridge to Campden Hill, and another separate main from Campden Hill, adjoining the New River Company's, which had just been coupled to one of the Grand Junction Company's service mains. The expense was included in the £255,000. They would also want more water; but this they could get by inter-sale with the Chelsea Company (the Thames-taking Companies having powers of inter-sale among themselves), or by increased power to pump from the Thames. This would not diminish the contribution of the Chelsea Company, because this Company made no contribution under the scheme. When the Staines reservoirs were completed, the Grand Junction Company would have power to take 12 million gallons more from the Thames. The absurdity was that Parliament put upon the Companies restrictions which prevented them from helping one another whenever they wanted to. The prohibition on the sale of water among the Companies should be abolished; and he expressed the opinion that the sinking fund should not be allowed to apply to any money raised for the present object, because these works must necessarily mean a diminution of the profits of the Company.

The CHAIRMAN: The whole quantity of water will be sold to some consumer or other?

Witness: It is expenditure of, I was going to say, unnecessary capital.

The water will ultimately be supplied on the ordinary terms, the same as any other water?—Yes. But we have to expend a large amount of additional capital to do it; and I say that this capital ought not to be subject to the sinking fund clauses.

Mr. PEMBER: It may be fifty years, and never used.

Witness: There is no extra water-rent coming in for it. There might be a recoupment in one year to one Company; but on the whole it will be absolutely out of pocket.

Mr. MELLOR: The question is what risk you ought to run?

Witness: Quite so; but I think it is a question on which Parliament should meet us in a fair and equitable spirit.

Sir G. BRUCE: Do you agree that this may be a desirable thing as a matter of insurance, but practically you do not expect it to be of use?

Witness: Practically I do not expect it to be of use after next year.

Mr. DE BOCK PORTER: You think the emergency provisions made this year will be sufficient to carry over another year to two?

Witness: Probably, with a little addition.

Mr. *Restler*, re-called and examined by the CHAIRMAN, said that the increase in the quantity of water supplied by his Company to the East London Company from 5 or 6 to 10 million gallons daily was limited to connecting the systems at the nearest possible point—viz., Southwark, where the Southwark and Vauxhall Company had a 20-inch main. There was a certain demand on this main in the Southwark and Vauxhall Company's own district; and to increase the supply through it, it was connected with a reservoir 200 feet, instead of to one only 150 feet above Ordnance datum. This worked fairly well. If it were sought to increase the quantity, there ought to be an additional main from Nunhead to the Tower Subway. Witness preferred No. 2 scheme, and believed that it would solve the whole difficulty. His Company were getting no water now from the Chelsea Company, the connection not yet having been made. But such a connection was practically arranged between the two Boards. If the connection were utilized, he supposed they would have to risk the legality of the use of the supplied water. The pipe across the Thames from his Company's district to that of the East London Company was carried through the Tower Subway under a seven years' agreement with the Hydraulic Power Company, to whom way-leave was paid. He did not think the size of the main could be increased; but by increasing the velocity of the water, they could add to the amount passing.

Some discussion then took place between Counsel as to the restrictions on inter-sale imposed by the various Acts of the Companies and as to the freedom which was given under the Thames Conservancy Act of 1894. But no general agreement was come to as to what were the powers and restrictions.

Mr. *T. F. Parkes*, Engineer to the Lambeth Company, said that, with their present plant and appliances, the Company could spare no water at all during their time of maximum supply—viz., July and August. Storage works at Molesey and new mains were about to be laid, which would enable the Company to contribute to an inter-communication scheme. A pumping-main from Ditton to Brixton, and an unfiltered water main from Molesey, would be proceeded with almost immediately. With these works, further powers to take more water from the Thames, and some new filter-beds, they might give, even during July and August, 5 or 6 million gallons. Then there was a well being sunk at Selhurst, which would give 2 million gallons daily; but this would not be completed for two or three years.

Cross-examined by Mr. FREEMAN: Their actual power of abstraction from the Thames was 24 million gallons daily; and during September their consumption was 31 million gallons. The balance was made up, not from the Thames, but from water pumped from the gravel beds near the Thames at West Molesey. He did not think this was Thames water. It stood in the gravel at a level below that of the river.

The Commission then adjourned.

The thirty-fourth sitting of the Commission was held yesterday—Lord Llandaff presiding. Mr. W. B. Bryan, the Chief Engineer to the East London Water Company, was called and examined regarding the Company's supply during the last few months. The population supplied was 1,800,000. In June last the average daily supply was 42,563,000 gallons; in July, 44,959,000 gallons; in September, 33,149,000 gallons; and in October, 34,202,000 gallons. Up to the 22nd of August, when the intermittent supply commenced, the figure was 43,107,000 gallons, and for the whole of the month it was 40,656,000 gallons.

Gift of Water-Works.—At a meeting of the ratepayers of Bulmer, one of the villages on the Earl of Carlisle's Castle Howard Estate, last Thursday, his Lordship's clerk of works (Mr. Reavell) stated that Lady Carlisle proposed to hand over the village water-works to the parish. They were constructed by the Earl a few years ago; and since they were opened, the tenantry have enjoyed a free supply of water, while freeholders using it have been charged a nominal sum. The Chairman (Mr. W. Peacock) characterized the offer as a very liberal one—a sentiment which was frequently reiterated during the meeting.

The Brightlingsea District Council and the Water-Works.—Last Thursday, Mr. H. P. Boulnois, one of the Local Government Board Inspectors, held an inquiry at Brightlingsea into the proposal of the District Council to borrow £9000 for the purpose of purchasing the Water Company's undertaking. Mr. W. I. Osborne, Clerk to the Council, stated that the area of the town was 2873 acres, with an estimated population of 4238 in 1897. The rateable value was £11,273, and at present there were about 1100 houses, 750 of which obtained their water supply from the Company, 380 depending upon surface wells. The Council had agreed to purchase the undertaking for £4500, and had acquired a site for the new well from which the supply was to be obtained. The Company's revenue in 1897 was £388. There were 380 houses which had no water, but which would be provided with a supply under the new scheme; and he estimated the revenue from these at £164—thus making a total of about £552. The expenditure was estimated at £168; leaving a net income of £384. If they borrowed the £9000 at 3 per cent., some £460 per annum would be necessary for repayment of loan and interest; and deducting from this amount the £384 net income, only £76 remained to come from the rates. The Council were satisfied that in three years the scheme would be a source of profit to the ratepayers. Mr. Goodyear, the Borough Surveyor and Engineer to the Council, gave details of the proposed new works, and said the tank would have a storage capacity of 71,000 gallons. Dr. Cooper, the Medical Officer of Health, supported the application.

METROPOLIS WATER SUPPLY.

Rainfall and Flood Water.

In their report to the Official Water Examiner for the Metropolis (Major-General A. de Courcy Scott), on the quality of the London Water Supply in the past month, Sir W. Crookes and Professor Dewar state that of the 182 samples examined by them, all were found to be clear, bright, and well filtered. The rainfall at Oxford during the month was 4·59 inches. As the average for the last thirty years is only 2·57 inches, there was an excess of 1·84 inches. This reduces the deficiency for the year to 6·38 inches, or 30·09 per cent. The report concludes with the following observations :—

The average daily flow of the Thames over Teddington Weir, for the present year to the end of the drought, is 550 million gallons, as compared with 826 million gallons, the average daily flow for the same period during the ten preceding years. Thus there has been a deficiency of one-third in the average daily flow of the river since the beginning of the year to Oct. 17, when the drought ended.

The extraordinary drought—the most severe for at least 40 years—having ended, there are several matters which deserve consideration. The average bacteriological condition of the raw unfiltered Thames and Lea waters during that period was exceptionally good, seeing that the bulk of the supply was spring water. The condition of the filtered water supplied to London was excellent; and in the case of the East London supply, the quality was substantially the same as during similar seasons when the supply of water was ample.

The large rainfall which took place in October has had the effect of suddenly washing into the rivers organic matter accumulated on the watershed during the three previous months; and as the reservoirs of the East London Company were almost empty at the end of September, the Company was forced, in October, to use the Lea, without the advantage of the purification resulting from proper storage in the reservoirs. During this critical time, we took extra pains to ascertain the character of the East-end supply, and additional samples were regularly taken from various points in the district. It is highly satisfactory to report that, in spite of the severe strain thus thrown on their filtering appliances, the clear water supplied to East London has been bacteriologically better than it was during the months of August and September.

It has been shown over and over again in these reports that, as a matter of fact, the bacteriological quality of the London Water Supply does not depend on the use or rejection of flood water, but upon the proper regulation and the efficiency of the filtration. This has long been conducted substantially under the supervision of the Official Water Examiner appointed under the provisions of the Metropolis Water Act, 1871. The direct use of water from the river during a prolonged flood, depending somewhat on the time of year, may result in the filtered supply containing in solution a little additional vegetable matter, thereby slightly adding to the brown colour; but, in our experience during the last fifteen years, we have seldom, if ever, known the colour of the London Water Supply, in its most peaty condition, to equal that of the average colour of Loch Katrine, Thirlmere, or the Welsh Lakes.

THE PROJECTED WELSH WATER SUPPLY SCHEME FOR LONDON.

The Report of Sir B. Baker and Mr. G. F. Deacon.

(*Concluded from p.* 1050.)

The fourth part of the report consists of the following concluding observations :—

In accordance with the terms of the reference, we have reported on the suitability and sufficiency of the Chief Engineer's proposed Welsh supply, and on the practicability and the cost of carrying out schemes of storage for providing 200, 300, and 400 million gallons per day respectively from the Thames on the lines of the Royal Commission report. The result of our investigations has led us to increase somewhat the magnitude of the works required for the Staines project, and in the Welsh project to omit some reservoirs and include others for compensation purposes. Having done this, we think the projects and the costs per unit as fixed by the projectors are fairly comparable.

The Welsh scheme would deliver water of unexceptionable quality—as good, no doubt, as the waters of Loch Katrine, Thirlmere, or Vyrnwy. Neither Glasgow nor Manchester thinks it necessary to filter such water. But Liverpool does filter it; and the Chief Engineer—rightly, we think—proposes that London should do the same. As to which portion of the Welsh scheme should be first carried out we cannot, in the absence of the necessary details and surveys, offer a final opinion; but, on the information before us, we think it probable that the Wye sources will prove the more generally advantageous.

If enlarged in the manner we have indicated, the Staines scheme would, we think, supply the stated quantities of water; but the quality, in our opinion, would not always be that apparently intended by the Royal Commission, since water in which the impurities were as great as they are on the average during the first 15 days of a flood of 2300 million gallons per day, would frequently be taken into the reservoirs, and even to the filters direct.

That the reservoirs would have a beneficial action in assisting the proper working of the filters we have no doubt; but we do not think any system of filtration, except a double and perfectly overlapping system, will at all times secure immunity from the passage of impure water, considering that, in the words of the Royal Commissioners, with which we concur, "a new filter"—*i.e.*, new in the sense of newly cleansed—"composed of perfectly purified sand, has little or no effect in producing either chemical or bacteriological purification."

Having reference to the character and extent of the present London water-works, and to the length of time which must elapse before any radical alteration of the system of supply could be effected, it is clear that neither the Staines nor the Welsh scheme, in its entirety, nor the estimate for either project, applies exactly to existing circumstances; and the most important and generally useful part of the reference to us is therefore the instruction to take into consideration the whole of the circumstances of the case, and to advise the Council whether, in our opinion, it would be more advantageous to bring into London from the proposed Welsh sources than from the Thames the additional quantity of water over and above the quantity at present supplied.

In considering the question from a practical point of view, it is necessary to remember that for the next ten or fifteen years the Thames must be the chief source of supply, and that there is little reason to suppose it will ever be entirely abandoned as an alternative or contributory source. In 1911, the quantity of water required by London will not, at the present rate of increase, exceed the existing powers of the Water Companies, which include supplies of 165 million gallons from the Thames and 120 million gallons from the Lea and elsewhere, or 285 million gallons in all; so that as regards statutory power no difficulty need arise from the delay incidental to the adoption of a Welsh project, except such as may be inseparable from the present divided administration.

We will for the purpose of comparative estimates assume that whether the Welsh supply be adopted or not, there would, before that supply could become available, be 165 million gallons per day taken from the Thames. The question, therefore, is whether twelve or fifteen years hence—say, in 1912—it would, on the whole, be more advisable to gradually increase that 165 million gallons as the growth of the population might require, or to introduce a supply of 200 millions in one or more instalments from Wales, and to correspondingly reduce the quantity pumped from the Thames and other sources.

As regards capital expenditure, no figures are required to show that it must necessarily be more costly to bring water from Wales than from Staines; and further, while the Welsh scheme must be commenced earlier than the Staines, and be completed to the extent of one or two reservoirs, and the greater part of one of the aqueducts, before it becomes available, while the latter may be completed in smaller sections, the interest during the construction must be somewhat greater proportionately than the capital expenditure in the respective cases. On the other hand, the working expenses would all be in favour of the Welsh scheme, by reason of the cessation of pumping charges, and the reduced working charges on filters and settling reservoirs.

We have considered many alternative ways of presenting our views as to the respective costs of the two systems of supply, and have thought, on the whole, that the price per 1000 gallons of water distributed would be the most generally understood unit of comparison. In relation to this comparison, it is to be observed that the Staines scheme can only be worked on the conditions laid down, if it is made to apply to the whole of the water drawn from the Thames—that is to say, not only to the increment of volume between the present and the later date, but to the original volume also. If it did not so apply, the reservoirs, in order to maintain a flow of 200 million gallons a day over Teddington Weir, would have to be very much larger and more costly.

Let us suppose that either one, two, or three instalments of one of the 200 million gallon Welsh schemes were brought to London in 1911, when the pumping from the Thames would be nearly the statutory maximum of 165 million gallons a day. A portion of the pumping expenditure on the Thames, and possibly on the Lea also, would immediately cease, and the present excess of pumping in dry weather would be relieved. The wet weather difficulty would also be removed, because turbidity would be confined to a much smaller quantity of water with which slower filtration could be practised, and if it were thought desirable that settling reservoirs should be constructed to prevent the choking of the filters during floods, their size would be insignificant by comparison with the huge storage reservoirs which the Staines scheme at present demands to prevent the fall of the river below 200 million gallons a day at Teddington.

If, on the other hand, an attempt were made to apply the Staines scheme as a general solution for the future, not only must it be applied to the various increments of supply after 1911, but to the whole quantity previously pumped also. If the necessary Act of Parliament were obtained in 1898, we think there would be no difficulty in securing Welsh water before 1911. In the alternative of the adoption of the Staines scheme, the works must be ready by the same date, and must have been constructed for the 165 million gallons a day, and for a small additional quantity to go on with, increasing to 66⅔ millions, *plus* that small additional quantity, in 1924, thirteen years later. We believe that such works would take about half as long to construct as the first instalment of the Welsh scheme, and we have apportioned interest on capital accordingly. The latter supplies from the Staines scheme (so far as it could be carried) might be extended in instalments of about 40 million gallons a day.

We will assume in the first instance that the whole of the 200 million gallons of Welsh water is brought to London in 1911, and that the pumping charges are proportionately reduced. Upon these conditions, on the views of the Royal Commission as to increase of population and of demand for water, and on the assumption that interest and sinking fund can be provided for a rate of 3 per cent., we arrive at the following conclusions regarding the relative costs per 1000 gallons of the additional supply from Wales and from the Thames: (*a*) That until 1911 the question of the relative cost per 1000 gallons does not arise. (*b*) That in 1911 the supply from the Thames would probably be 165 million gallons per day, and from other existing sources 120 million gallons; being 285 million gallons in all, which is the total quantity for which statutory powers have been at present obtained. With the additional quantity of 200 million gallons from Wales, this would suffice for London for a further period of 33 years after 1911, or until the year 1944, and additional supplies could be obtained from Wales as might be required. (*c*) That with the Staines reservoir project, in the same year (1944) the supply would be 365 million gallons from the Thames, and 120 million gallons from other sources. (*d*) Dividing the interval between 1911 and 1944 into three periods of eleven years each, we find that for the first period the extra cost of the purer and softer Welsh water would be less than 1d. per 1000 gallons; for the second period, less than ½d.; while for the third period it would be practically *nil*. The preceding figures would be varied if the 200 millions were brought from Wales to London in successive instalments, but not to an extent affecting the deductions to be drawn from them.

Our opinion as engineers as to what would be the "more advantageous" course to adopt, assuming the above estimates to be reasonably correct, is, of course, not worth more than that of others who are not engineers.

But we have been asked to give our "best advice to the Council;" and we therefore venture to make the following general remarks:—

The Royal Commissioners observe that they "are well aware that a certain prejudice exists against the use of drinking water derived from the Thames and the Lea, because those rivers are liable to pollution." On this we would remark that the two rivers are actually and seriously polluted; and it is impossible to foresee whether the prejudice on this account may not increase for the future. The Council have to consider, not what are the present views of the majority of the ratepayers, but what may possibly be the views of their successors, say twenty years hence; for it is the future rather than the present generation that would be most affected by any decision the Council may now make.

The whole history of the London Water Supply shows a steady and continuous demand on the part of the public for increased purity of water; and we have no reason to assume that the desire to get the purest water reasonably attainable will cease to grow. Experience elsewhere has proved that the quantity and quality of water insisted upon in any given place depend at least as much upon the "prejudices" and "sentimental objections" of the inhabitants as upon hygienic considerations.

Happily the evidence brought before successive Royal Commissions as to the general quality of water at present supplied, notwithstanding the pollution of the source of the supply, relieves the Council from the necessity of adopting any heroic measure, such as the entire abandonment of the Thames and Lea in the interests of public health; but it does not relieve them from the necessity of giving due weight, as regards any additional supply, to the "prejudice" which the Royal Commissioners refer to in their report. No one acting for himself personally with regard to a water supply to his own country house would allow a small difference in cost to determine whether he should go to a pure spring or to a stream into which some other house drained, although the latter might be so remote that he could allege no better reason for his decision than "prejudice." It appears to us that in coming to a decision upon so vital and irrevocable a question as the additional supply of water to London for a long series of years, the safer course would be to act for future generations as our instinctive and deeply-rooted feelings in favour of pure water would lead us to act for ourselves. It is true that the results of chemical and biological researches in relation to filtered Thames water are eminently reassuring; but it is necessary to remember that science has not said the last word on this or any other subject.

In following the course suggested, entire consistency, we venture to think, would be preserved with the admittedly proper action of public bodies generally in matters relating to pure air and pure water. Thus the restriction of the heights of houses in streets of certain width, and the pecuniary loss thereby imposed upon owners, is justified upon broad general principles, and not upon the number of bacteria observable in different streets. It is held reasonable also to insist upon certain minimum heights of rooms in new buildings as conducive to purity of air, although this involves increased cost; but it would be held unreasonable, except in extreme cases, to order the demolition of existing and otherwise good buildings because they did not comply with the same requirements. Similarly, it might be considered unreasonable to dispense with the existing water supply from the Thames and the Lea, and at the same time quite reasonable to insist upon an unpolluted supply for future requirements, and this notwithstanding that some increase in cost may be involved.

It is hardly necessary to observe that the Royal Commissioners, in their report, recommend on hygienic grounds that the water should be delivered for consumption in as unpolluted a condition as large subsidence reservoirs, perfect filtration, and the exercise of all possible vigilance in preventing unnecessary contamination of the Thames would admit; and *a fortiori*, apart from the question of cost, an initially unpolluted supply must have met their approval. The Commissioners also acknowledge the existence of a "not unnatural sentiment against drinking water which, though wholesome, has been polluted at an earlier stage;" and the strongest advocates of the Thames supply admit that the wholesomeness of such water depends upon efficient filtration which has not always been secured in the past.

Apart, however, from satisfying sentimental objections and hygienic doubts, the adoption of the Welsh project for additional supplies would have the further advantage of introducing a volume of soft water to London, and of leaving a corresponding body of land water in the river to dilute the sewage, and to clear the bed and banks of deposits.

As regards the first point, we adopt the conclusion of the Duke of Richmond's Commission of 1869—"That, for washing and for manufacturing purposes generally, soft water is preferable, as more efficient and economical; but there appears no means of expressing the amount of saying in a money estimate." We agree also that this advantage does not in itself render it "necessary" to go to a great distance for soft water. As regards the abstraction of water from the Thames, there is even a greater difficulty in expressing the results in a money estimate; but we do not think any hydraulic engineer would question the serious disadvantage of extending the present period of minimum flow of 28 days in any year to more than 200 days.

Summarizing our views generally "on the whole of the circumstances of the case," and therefore sometimes upon matters governed by personal feeling rather than by engineering principles, which we should not have ventured to do had the terms of the reference not imposed this duty upon us, we may state our general conclusions as follows:—

1.—That for the next ten or fifteen years the Thames must necessarily remain the chief source of supply for London.

2.—That together with the wells and probably the Lea, the Thames will always be maintained as an alternative or contributory source of supply, if for no other reason than that set forth by the Duke of Richmond's Commission—namely, the undesirability of any change by which the Metropolis would become dependent upon a single source of supply which might be liable to accidental interruption.

3.—That the evidence brought before the Royal Commission as to the quality of the existing supply when perfectly filtered shows that there is no reason for entirely abandoning the present sources of supply, though views differ widely as to the maximum quantity which may be taken from the Thames with impunity.

4.—That the practical question for decision within the next year or two is whether twelve to fifteen years hence the additional supply shall come from the Thames or from Wales.

5.—That the personal prejudices and sentiments of the public, rather than the opinions of engineers, chemists, and accountants, are the most powerful factors in deciding such questions, and therefore it is not necessarily a wise course to accept the lowest tender and take an inferior article where water supply is concerned.

6.—Personally, we should feel no hesitation in deciding that the *additional* supply of water should, as far as possible, come from Wales, because we should then, in our opinion, have had all reasonable regard both to true economy and to existing and future prejudices and sentimental or real objections to an initially polluted and subsequently more or less purified supply. We should in short be doing for the population collectively what we should be doing for ourselves individually in going to a pure spring, if there were one reasonably available, for our own domestic supply, although it might involve a little more trouble and expense.

7.—The extra trouble and expense to individual households in London of getting the additional supply of water from the purest source available rather than out of the nearest stream would be insignificant compared with that willingly incurred by country residents and cottagers for the same object, since on the basis of the figures given in this report for the first 200 million gallons a day, it would involve an additional expenditure of less than a penny per week for an average household, whilst for the second instalment of 200 million gallons the Welsh water would be the cheaper of the two.

TORQUAY CORPORATION WATER ARBITRATION.

(*Before Mr.* E. P. Squarey, *Umpire.*)

Arbitration proceedings were commenced at Exeter on Thursday, the 3rd inst., to determine the value of certain land which the Torquay Corporation propose to acquire in the Trenchford Valley, part of the watershed which they are authorized by their Act of last year to purchase. Mr. H. Drew was Arbitrator for the claimants; Mr. A. Rendall for the Corporation.

The first case taken, which related to the value of land, was that of Mr. G. Wills, the owner of the Pepperton Estate.

Mr. H. E. Duke, opening his case, pointed out that the estate formed part of the watershed; and if they did not acquire it, the Torquay Corporation would have to become customers of Mr. Wills, which gave it an extra value. It had been estimated that on this land they could be sure of getting 120 million gallons of water, which without compulsory powers the Council would be bound to have from him. The Torquay water was sold at 1s. 4d. per 1000 gallons; and if they put on a royalty of ¼d. per 1000 gallons it would produce £225 per annum.

Mr. *Wills*, who described himself as an Australian merchant, said he did not wish to sell the land. He was brought up on it; and it was the ambition of his life to farm it. He would be willing to pay the Corporation £5000 if they would withdraw their proposal. He paid £6850 for the Moor Barton farm, £1800 for Didworthy, and £3045 for Pepperton; and he had spent £4400 on improvements at Didworthy, and £6700 on improvements at Moor Barton. He had no vouchers for these payments. It was not a financial speculation on his part, but a hobby; and he may have spent money foolishly.

Mr. *A. E. Ellis*, a land valuer and surveyor of Exeter, said that the Pepperton Estate consisted of 1173 acres, of which the Corporation proposed to take altogether 422 acres. His estimate of the value of the land was as follows: 231 acres at Moor Barton, net rental £274, which at 30 years' purchase was £8220; sporting rights value, £600; timber at a valuation, £1250; machinery, £50; compulsory purchase, 25 per cent., £2560; severance damage in respect of the 102 acres, £510. On the same lines he put the value of Didworthy at £6195, and added £1500 in respect of damage sustained as a residential property.

Cross-examined: The price for the Moor Barton property worked out at £55 or £56, and for the other land at £32 an acre. He was not aware that other property was bought by the Corporation in the same neighbourhood for £15 5s. an acre.

Similar evidence was given by Mr. *A. Loveys*, of Moreton Hampstead, and Mr. *H. Drew*, of Exeter.

Mr. *G. D. Bellamy*, Consulting Engineer to the Plymouth Corporation, said the whole land was more or less water bearing. He had taken the mean rainfall at 35 inches, which was the lowest he could find. He estimated that 40 per cent., or 14 inches, could be collected. The area that could be underdrained was, he believed, 332 acres; and, roughly speaking, they would be capable of collecting 121 million gallons per annum. At a low charge of ¼d. per 1000 gallons, this would bring in a revenue of £252 a year, which might be capitalized at 20 years' purchase. Looking at the nature of the Torquay water undertaking, he considered that this added to the value of the land.

Mr. Balfour Browne asked witness if he considered that the rainfall on this land was worth £7500 a year.

Witness said he thought it was worth ¼d. per 1000 gallons. He had not calculated how much it would cost to collect the 120 million gallons. Torquay might be getting all this water now, but it could be diverted by the owner of the land.

Mr. Balfour Browne, for the Corporation, agreed that Moor Barton was a good farm, and had been much improved; but he said it was a novel expedient to take all the money spent on it, add it to the original purchase-money, and say that this represented the present value. Moreover, 30 years' purchase was too high a figure; and the most that could be expected from the Corporation was 25 years' purchase, which, at their estimate of the rental—£200 gross and £166 net—worked out at £4150. Mr. Bellamy's figures about the water had surprised him; and he submitted that no claim could be made in respect to that. Allowing for the compulsory sale, the severance, timber, and machinery, the Corporation put the value of Moor Barton at £5750, and of Didworthy at £2897, or a total of £8647. This was nearly half of the lowest of the claimant's figures, which, for a compensation case, was almost unanimity.

On the resumption of the proceedings on the following day, Mr. *A. S. Rendall*, Mr. *E. J. Sawdye*, and Mr. *A. Body* gave evidence on behalf of

the Corporation as to the value of the estate; and Mr. *W. Ingham*, Water Engineer to the Torquay Corporation, put in returns as to the rainfall.

In the case of Mr. William Addems, the owner of the Clampitt farm, the valuations were as follows: Mr. Loveys, £5900; Mr. E. Desmond, £5761; Mr. Drew, £5940. For the Corporation, Mr. Rendall's estimate was £3025; Mr. Body and Mr. Sawdye corroborating.

The Trustees of the late Thomas Loveys claimed £5200 in respect of the Kennick farm; while the Corporation witnesses put the amount at only £3000.

In the case of the Trustees of the late William Addems, £950 was claimed for part of the Elsford farm. The valuation according to the Corporation witnesses was from £400 to £500, including compensation for severance.

The sitting was concluded on the 5th inst., when the case of the Bullator farm was taken. The owners put their claim for compensation at between £2500 and £2800, while the witnesses for the Corporation held that the value was not more than £1530. In the case of Mr. N. Addems, of the Middle Westcott farm, the claim was £860, and the Corporation value £200.

STOCKTON AND MIDDLESBROUGH WATER SUPPLY.

The Grassholme Reservoir Scheme.

At the Meeting of the Middlesbrough Town Council last Wednesday, Alderman Bell moved resolutions sanctioning application to Parliament by the Joint Water Board to alter the name, if desired, to amend the Act of 1876 in connection with the Grassholme reservoir, to secure some modification of the obligation to supply water to manufacturers at 3d. per 1000 gallons, and to increase the Board's borrowing powers by £344,304. The Alderman explained that they had only powers at present to supply, out of the quantity of water at their command, 100 million gallons per week; and as they were already supplying 82 millions, it was necessary that they should exercise their further powers to construct the Grassholme reservoir, to enable them to provide 190 million gallons per week. If the growth of the district continued in the future, as they had reason to expect it would, it would mean that in ten years, which were needed to construct the reservoir, they would be requiring more water than they had. It was true that this would be a demand upon the ratepayers' money of £16,000; but £10,000 would be for redemption—thus buying a valuable property, although the balance, no doubt, was a direct loss. But their position in ten years would be that only a loss of £2600 per annum would be involved on the assumption that they then supplied 95 million gallons per week. The probability, however, was that they would supply nearer 100 million gallons; and every gallon of water they sold would be a reduction of the charge upon the rates. They would have 190 million gallons available; and they could widen their area of supply. Every million gallons sold means a relief of £15 or £16 per week to the rates. He was sanguine the deficit would soon be wiped off. They were administering the works much cheaper than the old Company, whose cost was £3 10s. 1d. per million gallons, against £2 14s. to-day. Several members of the Council wished for an adjournment, to consider so vast a scheme. Alderman Bell explained that notices must be published by the 19th inst., and there was not time; but that the Council were only committing themselves to a general resolution, and he would guarantee ample opportunity for full discussion of details. He would undertake, moreover, that if the Council were not convinced of the necessity of the steps suggested, the Bill would not be proceeded with. The resolution was adopted by 17 votes to 16. In the Stockton Town Council this matter was discussed on the same day, and adjourned till Friday.

Bedworth Water Supply.—The ceremony of laying the foundation stones of the water-tower in connection with the Bedworth Water-Works was performed on the 5th inst. The stones were laid by the Chairman and Clerk of the Foleshill District Council, the local representatives of the Council, the Chairman, Vice-Chairman, and Secretary of the old Parochial Committee, and the Chairman of the Bedworth Parish Council. The works have been entrusted to Mr. Amos Jenkins, and they will cost £9700. Mr. H. B. Nicholls, of Birmingham, is the Engineer of the scheme. The yield of water has averaged 210,240 gallons in 24 hours; and as only about 80,000 gallons are required at present, the supply will be ample for the needs of the district.

Water Divining.—A water-finder recently met with some success on an estate near Chippenham. He located a spring at 100 feet, and sank a 6-inch artesian tube-well, with the result that water has been found at 104 feet. It was a mineral spring. A second spring was located about 400 yards from the first; the estimated depth being 150 feet. Water was found at 158 feet. This proved to be a magnesia spring. There was about 110 feet of water in the well, which was pumped four days at the rate of 17,280 gallons per day. The same diviner located excellent springs on an estate near Brighton. He sank a 6-inch artesian well, and found an abundant supply of water; and a 9-inch one, which will run double pumps, is to be sunk, as well as a 6-feet external diameter cylinder well to the depth of 200 feet.

Otley Water Scheme.—The Otley District Council on the 7th inst. decided to promote a Bill in Parliament to carry out the new scheme of water supply which was referred to in a paragraph last week. The resolution stated that the Bill is "to enable the Council to purchase (otherwise than by agreement) the water rights of certain owners of a stream called Bow Beck, situated at Middleton and Denton, and the right to lay water-pipes and make conduits through certain lands at Middleton, Denton, Askwith, Weston, and Newall-with-Clifton, and also to purchase (otherwise than by agreement) land in one or more of the said townships, for the purpose of constructing a reservoir or reservoirs, and to construct such other works as may be necessary for improving the supply of the said district with water from the said stream." The estimated cost is £35,000. The Ilkley District Council have appointed a Committee to see that their interests are not prejudicially affected by the scheme.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

Referred to on p. 1084.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p. c.	GAS COMPANIES.			£ s. d.
690,000	10	Oct. 13	10½	Alliance & Dublin 10 p. c.	20½—21½	..	4 17 8
100,000	10	"	7½	Do. 7 p. c.	16—17	..	4 8 3
800,000	100	July 1	5	Australian 5 p. c. Db.	105—107	..	4 13 6
200,000	5	Nov. 11	6	Bombay, Ltd.	6¼—6¾*	..	4 2 11
40,000	5	"	6	Do. New, £4 paid	4½—4¾*	..	5 1 1
380,000	Stk.	Aug. 12	12	Brentford Consolidated	275—280	..	4 5 9
240,000	"	"	9	Do. New	210—215	..	4 3 9
50,000	"	"	5	Do. 5 p. c. Prf.	140—145	..	3 9 0
159,375	"	June 10	4	Do. 4 p. c. Db. Stk.	130—135	..	2 19 8
220,000	Stk.	Sept. 15	11½	Brighton & Hove, Orig.	263—268	..	4 5 10
226,320	"	"	8½	Do. A. Ord. Stk.	190—195	..	4 7 2
933,500	Stk.	Aug. 31	5	Bristol, 5 p. c. max.	125—130	..	3 16 11
420,000	20	Sept. 29	10	British	49½—50½	..	3 19 1
50,000	10	Aug. 12	11½	Bromley, Ord. 10 p. c.	25—27	..	4 5 2
75,000	10	"	8½	Do. 7 p. c.	20—22	..	3 17 3
500,000	10	Oct. 13	6	Buenos Ayres (New) Ltd	9¼—10	..	6 0 0
98,122	Stk.	June 29	4	Do. 4 p. c. Db. Stk.	98—100	..	4 0 0
150,000	20	July 14	8½	Cagliari, Ltd.	29—30	..	5 10 0
100,000	10	Sept. 29	7	Cape Town & Dis., Ltd.	14—15	..	4 13 4
50,000	50	Nov. 2	6	Do. 6 p. c. 1st Mort.	57—59	..	5 1 8
550,000	Stk.	Oct 13	13½	Commercial Old Stock	310—320	..	4 4 5
200,750	"	"	10½	Do. New do.	247—252	..	4 3 4
200,750	"	June 10	4½	Do. 4½ p. c. Db. do.	148—153	..	2 18 10
800,000	Stk.	June 10	12	Continental Union, Ltd.	207—212	..	5 13 2
200,000	"	"	9	Do. 7 p. c. Prf.	193—198	..	4 10 11
51,600	Stk	Aug. 31	14	Croydon A 10 p. c.	305—3 0	..	4 10 4
168,400	"	"	11	Do. B 7 p. c.	255—265	..	4 3 0
555,000	Stk.	Aug. 12	5½	Crystal Palace Ord. 5 p. c.	125—130	..	4 0 9
60,000	"	"	5	Do. 5 p. c. Prf.	140—145	..	3 9 0
486,090	10	July 28	11	European, Ltd.	23—24	..	4 11 8
354,060	10	"	11	Do. £7 10s. paid	17—18	..	4 11 9
5,922,230	Stk.	Aug. 12	12½	Gaslight & Coke, A, Ord	286—291	−2	4 4 0
100,000	"	"	4	Do. B, 4 p. c. max.	120—125	..	3 4 0
665,000	"	"	10	Do. C, D, E, 10 p. c. Prf.	308—311	−1	3 4 4
30,000	"	"	5	Do. F, 5 p. c. Prf.	152—157	..	3 3 8
60,000	"	"	7½	Do. G, 7½ p. c. do.	230—240	..	3 2 6
1,900,000	"	"	7	Do. H, 7 p. c. max.	195—200	..	3 10 0
463,000	"	"	10	Do. J, 10 p. c. Prf.	308—313	..	3 3 11
476,000	"	"	6	Do. K, 6 p. c. Prf.	185—190	..	3 3 2
1,061,150	"	June 10	4	Do. 4 p. c. Db. Stk.	131—133	..	3 0 2
294,850	"	"	4½	Do. 4½ p. c. do.	148—153	..	2 18 10
958,000	"	"	6	Do. 6 p. c. do.	195—200	..	3 0 0
70,000	10	Nov. 11	8	Hongkong & China, Ltd.	13—14*	−½	5 14 4
3,800,000	Stk.	"	10	Imperial Continental	217—222*	−1	4 10 1
376,400	100	Aug. 2	4	Do. 4 p. c. Dbs. Red.	98—101	..	3 19 8
473,600	Stk.	Aug. 12	3½	Do. 3½ p. c. Db. Stk.	102—105	+1	3 6 8
560,000	100	Oct. 1	5	Met. of Mel- bourne	5 p. c. Db.	110—112	..	4 9 3
250,000	100	"	4½		4½ p. c. Db.	105—107	..	4 4 1
					* Ex div.		

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p. c.	GAS COMPANIES.			£ s. d.
75,000	5	June 29	6	Malta & Medn., Ltd.	4⅜—5⅛	..	5 14 3
541,920	20	Nov. 11	5	Monte Video, Ltd.	13—14*	..	7 2 10
617,946	Stk.	Aug. 31	9½	Newc'tle & Gatesh'd Con.	230—240	..	4 1 3
252,355	Stk.	Jan. 3	3½	Do. 3½ p. c. Db. Stk.	113—117	..	2 19 10
150,000	5	May 26	8	Oriental, Ltd.	7⅛—7⅜	..	5 3 3
135,000	5	"	8	Do. New, £4 10s. pd.	6½—7	..	5 2 11
15,000	5	"	8	Do. do. 1879, £1 pd.	1⅞—1⅞	..	4 11 5
60,000	5	Sept. 29	7	Ottoman, Ltd.	5—5½	..	6 6 2
500,000	100	June 1	6	People's Gas of Chicago 2nd M. Bd.	103—108	..	5 11 1
848,070	10	Oct. 13	6	River Plate Ord.	9—9½	..	6 6 4
250,000	Stk.	June 29	4	Do. 4 p. c. Db. Stk.	99—101	..	3 19 3
250,000	10	Sept. 29	10	San Paulo, Ltd.	14½—15½	..	6 9 0
135,000	Stk.	Sept. 15	10	Sheffield A.	242—245	..	4 1 8
209,053	"	"	10	Do. B.	242—245	..	4 1 8
447,427	"	"	10	Do. C.	242—245	..	4 1 8
5,600,000	Stk.	Aug. 12	5⅜	South Metrop., 4 p.c Ord.	138—142	..	3 15 1
1,460,000	"	July 14	3	Do. 3 p. c. Db. Stk.	102—105	..	2 17 2
60,000	Stk.	Aug. 31	12	Tottenham and Edmonton A. B.	280—290	..	4 2 9
60,000	"	"	9		200—210	..	4 5 9
182,380	10	June 10	7	Tuscan, Ltd.	10½—11½	..	6 1 9
149,900	10	July 1	5	Do. 5 p. c. Dbs. Red.	100—103	..	4 17 1
				WATER COMPANIES.			
746,164	Stk.	June 29	10½	Chelsea, Ord.	313—318	..	3 6 0
150,000	"	"	5	Do. 5 p. c. Prf.	170—175	..	2 17 2
160,000	"	"	4½	Do. 4½ p. c. Pf. Stk., 1875	148—152	..	2 19 3
175,785	"	Sept. 29	4½	Do. 4½ p. c. Db. Stk.	155—160	..	2 16 8
1,720,560	Stk.	Oct. 13	7	East London, Ord.	212—217	..	3 4 6
654,740	"	June 29	4½	Do. 4½ p. c. Db. Stk.	157—160	..	2 16 3
390,000	"	"	3	Do. 3 p. c. Db. Stk.	103—105	..	2 17 2
700,000	50	June 29	7½	G'd Junct'n, 10 p. c. max.	115—118	..	3 3 7
310,000	Stk.	Sept. 29	4	Do. 4 p. c. Db. Stk.	138—143	..	2 15 11
708,000	Stk.	Aug. 12	14	Kent	365—370	..	3 15 8
160,000	"	"	7	Do. New, 7 p. c. max.	212—217	..	3 4 6
1,043,800	100	June 29	10½†	Lambeth, 10 p. c. max.	300—305	..	3 8 10
406,200	100	"	7½	Do. 7½ p. c. max.	228—233	..	3 4 4
350,000	Stk.	Sept. 29	4	Do. 4 p. c. Db. Stk.	138—143	..	2 15 11
500,000	100	Aug. 12	13½	New River, New Shares	435—440	..	3 0 2
1,000,000	Stk.	July 28	4	Do. 4 p. c. Db. Stk.	138—143	..	2 15 11
902,300	Stk.	June 29	6	Southw'k & V'xhall, Ord.	165—170	..	3 10 7
126,500	100	"	6	Do. do. 7½ p. c. max.	160—165	..	3 12 9
489,200	Stk.	"	5	Do. do. 5 p. c. Prf.	170—173	..	2 17 10
1,019,585	"	Oct. 13	4	Do. 4 p. c. A Db. Stk.	138—143	..	2 15 11
1,155,066	Stk.	June 10	10	West Middlesex	295—300	..	3 6 8
200,000	"	"	4½	Do. 4½ p. c. Db. Stk.	162—165	..	2 14 7
200,000	"	Sept. 15	3	Do. 3 p. c. Db. Stk.	102—105	..	2 17 2
					* Ex div.		

† Next dividend will be at this rate.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

This has been a week of fog such as I do not remember to have seen equalled, not on account of its density, but of its duration. During the four days from Tuesday to Friday, the air was damp and chilly, and banks of fog rolled over the landscape. In cities and towns artificial light was very much in use during the day in business premises; but I do not think it was necessary in any case to light the street-lamps. The lighting which was had recourse to will, however, undoubtedly put up the statistics of output for the month of November. That is so far good. The other side of the question is the cost which has been incurred to meet the sudden demand; and there is also the inconvenience and anxiety which such a prolonged period of darkness entails. Gas managers will have tales to tell of their experiences during this foggy November. So far as I have ascertained, they seem all to have struggled through without having been under the necessity of curtailing any of their supplies. How different it has been with the electric light! In Edinburgh, which has been held up to the whole world as exhibiting one of the best planned and best conducted electric light installations in existence, what a falling off there has been! First of all, during the whole of the week only half the street arc lamps have been lighted—that is to say, every alternate lamp—an arrangement which very frequently led to one side of a street being lighted, and the other dark. The state of matters would have been bad enough in good weather; but in the midst of a fog it was neither pleasant nor safe to be in an electrically lit street after dark. Then, at the beginning of the week, there came an apology, published in the form of a newspaper paragraph, and afterwards advertised, for not being able to keep up the usual pressure; the reasons given being the great extension of the electric lighting system, and the failure of contractors to supply new plant which had been ordered. Everyone will be disposed to sympathize with the Committee under the latter head; but sympathy should not be carried too far, because the Committee ought to have foreseen the difficulty in delivery, and should either have given their orders earlier, or else have refrained from taking new orders for current. I suppose it will be said that the Corporation are liable to penalties if they do not supply current when required; but their position, in this respect, is an enviable one when compared with that of the Gas Commissioners. In the electrical department, it is provided that in no case shall any penalty be inflicted if the Court shall be of opinion that the default was caused by inevitable accident or *force majeure*. There is no such saving clause in the case of gas supply. Nay, more; with electricity all that is required by law is that energy shall be supplied. In regard to gas there are penalties for failure to give supplies, both to private consumers and to public lamps; and there are also penalties, in addition, for failure to give a supply of gas of a certain prescribed pressure, or of a certain illuminating power. A gas supplying body has no appeal to the Board of Trade on the plea of accident; they are at the mercy of a petty tribunal, whose decision, upon matters of fact, is final. All this furnishes a good reason for the action of the Electric Lighting Committee of the Edinburgh Corporation. They supplied current, so far as in their power, and thus escaped liability for the statutory penalty. But what a sorry spectacle their supply was. At six o'clock last night, I walked along several streets which they light. In the shops where incandescent electric lamps were being used, one could scarcely see the length of the counter. In those where ordinary gas-burners were employed the light was ten-fold better; while shops which were lighted by incandescent gas-burners were a blaze of illumination. There was no failure of the gas supply. It was an object-lesson as to the reliability and efficiency of gas, under all conditions, as compared with the liability to failure of the electric light. But there is more than this. If the Legislature see fit to impose stringent regulations as to the lighting power of gas, what reason can there be for other illuminants not being subjected to like requirements? We have been told that the electric light is always of the same power; but no one who saw Edinburgh this week will again maintain that. The illuminating power given out was not that specified in connection with any size of lamp. A 16-candle lamp was only giving a light equal to 1 or 2 candles. The law requires amendment here. Then there is also the failure to light the street-lamps. When electricity was introduced, the Electric Lighting Committee removed the gas-lamps from the streets; but this week has shown the folly of the step. The appearance of the streets is doubtless improved by the absence of disused gas-lamps; but had they been there this week, the thoroughfares would have been better lighted. I suppose that a penalty for failure to supply energy for public lamps would apply to the Electric Lighting Committee; but there again, were it attempted to be enforced, they would escape liability, because they did not fail to supply energy. They were only guilty of providing an inadequate supply, as to which the Board of Trade require to be moved before anything can be done; and the saving clause would again come in. There is truly, in the matter of artificial lighting, one law for the one and another law for the other illuminant.

The new Gas Bill of the Corporation of Glasgow is already being put into shape. This week the Town Clerk (Sir James Marwick), with his Deputy in the Gas Department (Mr. Bowers), and Mr. Johnston, an assistant, have been in London arranging for the lodging of the statutory Parliamentary Notices. The ground scheduled extends to 121 acres, on the lands of Blochairn, Milton, and Blackhill, in the Barony Parish, and situated partly in the city and partly in the county. Notice is also being given of the intention of the Corporation to acquire 9 acres of land on the estate of Garscube, in the parish of New Kilpatrick, for the extension of the chemical works of the Dawsholm gas-works. This is carrying business out with a promptitude which is unknown in other corporations. In the case of some corporations, indeed, a scheme of the magnitude of the one upon which the Glasgow Corporation have embarked, would have formed a subject of discussion for quite two years. Instead of that, about a month sufficed in Glasgow for the public consideration of the question. Of course, it had been carefully considered in private before, which, perhaps, makes nearly all the difference between the treatment of large questions in Glasgow and some other places.

The water-pipe contract was again before the Water Committee of the Glasgow Corporation on Monday. Rather a new turn was given to the

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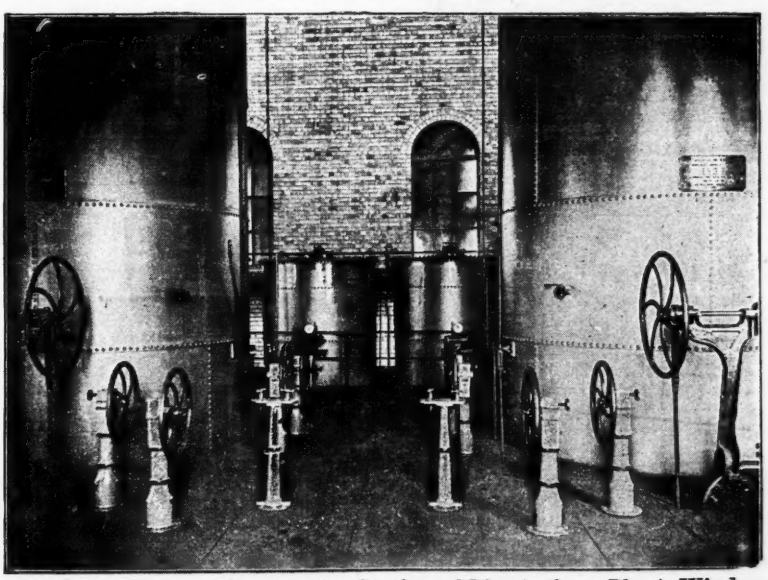

RESULTS PROVE EFFICIENCY.

Working Floor of Generator House. One Quarter Section of Birmingham Plant, Windsor Street Station.
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subject by the disclosure of the circumstance that Messrs. R. D. Wood and Co., of Philadelphia, are unable to deliver within the specified time the 1000 tons of pipes of various sizes which they had contracted to supply. It was understood to be one of the special pleas for the sending of the order to America that there would be no risk of delay in delivery. Such is not the case, however; and the Committee, being in want of pipes at once, agreed to order what they require from Messrs. R. Maclaren and Co., of Glasgow, and to charge Messrs. Wood with the difference in cost. At the same time, it is given out, the Committee will take from the American firm the full quantity contracted for.

This week there have been two explosions of gas—one in Glasgow and the other in Arbroath—both of which are popularly described as serious. The Glasgow one occurred at one o'clock yesterday (Friday) morning. The scene was a tenement of four storeys in Baltic Street, Bridgeton. It is only a few years old; and, what is almost always the case in gas explosions, the parties in the two dwellings on the ground floor, in which the explosion occurred, did not use gas. The wall separating the two dwellings from the entrance passage, was blown down, the staircase being nearly blocked up by the debris; and the furniture in both dwellings was badly wrecked. Two persons were slightly injured; but several others fortunately escaped without being hurt. Twelve families have, however, been ordered out of their homes until the tenement is repaired. There is as yet no theory as to the cause of the explosion. It is, however, stated that one woman, noticing a smell of gas, attempted to strike a match; but having failed once or twice, she gave up the attempt. The surmise is made that she had opened the door of her dwelling, allowing the gas inside to come into contact with the light in the common stair. The Arbroath explosion also occurred between twelve and one o'clock yesterday morning. There is no mystery about it. A road-roller was at work in Glover Street on Thursday, working backwards and forwards over a gas-main which is a little more than a foot from the surface of the street. It has since been discovered that the main has been fractured in about six places. One of these fractures was opposite No. 18, below which tenement there is a built drain; and the escaped gas accumulated in the drain. It was smelt in the house; and Corporation workmen had been searching all night for the fracture in the pipe. There were nine persons in the house, all of whom were in bed except the father and a son. They were preparing to retire; the father intending to go upstairs, and the son to go into a bed in a back apartment on the ground floor. There is little doubt that it was the movement of these men, or the lighting up of new lights, which led to the ignition of the gas. The damage to property is described as extensive; but the inmates were only slightly injured, beyond shock, and are reported to be almost recovered. In the course of yesterday, it was discovered that an old woman who resides at No. 6 in the same street, was almost poisoned by gas which had escaped from another fracture of the main. It was observed that she was not moving about, and her house was forcibly entered, when she was found in bed in an unconscious condition. It is expected that she will recover.

The Corporation of Dundee seem to have a return put before them monthly, giving particulars of the gas supply and consumption. On Monday, at a meeting of the Corporation, Bailie George Stevenson wished the return widened so as to include the revenue derived from residual products. It was explained to him that in Dundee they only sold residuals when the market was suitable, and some months they sold none at all. The suggestion was made that such a return would serve no good purpose. The reason for the proposal being made appeared to be embodied, in the remark of another member, to the effect that it had been stated that someone could make £2000 a year out of the residuals, without anything being known about it. I suppose this would be an elector's suggestion at some of the recent meetings. It was warmly resented by Mr. Brownlee, the Convener of the Gas Committee, who probably saw in the proposal an insinuation, not of actual deeds, but of possibilities within his power which might be used. If there were any such insinuation, it was a most unworthy one. Were it possible that the members of the Gas Committee, or any of them, were corrupt—as to which perish the thought—defalcations on their part could not escape the Auditor.

The Arbitrators' awards have been issued in connection with the arbitration proceedings between the Clippens Oil Company, Limited, and the Edinburgh and District Water Trust, which took place recently before Messrs. J. Gemmell and D. Rankine as Arbitrators, with Sheriff Jameson, Q.C., as Umpire. In the first reference, the Company claimed £16,750 as compensation in respect of the minerals left unworked in certain parts of the lands at Straiton. The respondents pointed out that the shale pillars and limestone pillars left in the workings, in respect of which compensation was asked, were formed and left without any intention of being worked out, and that they could not be worked out at a profit or without removing the supports of the public road and buildings adjoining. The Arbitrators have found the claimants entitled to the sum of £8079 in respect of these minerals left unworked as loss and damage occasioned to the Company by the non-working thereof. In the second reference, the Oil Company claimed the sum of £20,000 as compensation in respect of freestone left unworked under and alongside of the Moorfoot pipe belonging to the Trustees, in the vicinity of the Company's works. The respondents maintained that the amount claimed was grossly excessive. The Arbitrators have found the claimants are entitled to a sum of £2250 as compensation.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *Nov.* 12.

Sulphate of Ammonia.—There has again been an active market and a further advance in values; closing quotations being £10 per ton f.o.b. Hull, and £10 2s. 6d. f.o.b. Leith and Liverpool. The largest demand has been for immediate delivery; and, prices being tempting, makers everywhere have offered their production as it has become available. The larger makers have also sold a considerable portion of their November output. There has been good inquiry from abroad, and a fair amount of buying; but consumers and distributors have not altogether followed the recent sharp advance. In the early part of the week, there was further speculative forward buying at up to £10 2s. 6d. per ton f.o.b. Leith, November-

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December and January-June delivery; but buyers hesitate to pay the further 2s. 6d. a ton since required. London (Beckton terms) is quoted £10 per ton, January-June delivery.

Nitrate of Soda is firm in all positions; and the spot quotation is 7s. 7½d. per cwt. for fine quality.

LONDON, *Nov.* 12.

Tar Products.—Distillers are much disquieted at the low price to which anthracene has fallen, and its continued depression, notwithstanding the lessened and still decreasing output. In former times, anthracene was one of the principal products of tar in respect to value. Its present unsaleable condition is making itself felt all round. Low prices continue to be accepted for crude naphthas; but a large business is, notwithstanding, being done in it—makers preferring to sell at low prices, rather than stock such an inflammable article. There is no improvement at all in benzols—indeed, if anything, they are weaker, while solvent and heavy naphthas move off moderately well. Carbolic acid is not quite so strong; and crystals are offering at less money. Creosote is firm; and pitch maintains its improved value.

The week's average prices are: Tar, 14s. 6d. to 20s. Pitch, east coast, 25s.; west coast, 22s. Benzols, 90's, 8½d.; 50's, 9d. Toluol, nominal, 1s. 0½d. Solvent naphtha, 1s. 2d. Heavy naphtha, 1s. 1½d. Crude, 30 per cent., naphtha, 3½d. Creosote, 3d. Heavy oils, 45s. Carbolic acid, 60's, 1s. 11d. Creosote salts, 30s. Anthracene, nominal, "A," 4d.; "B," 3d.

Sulphate of Ammonia.—A much better tone pervades this market; and prices in all positions have steadily improved. There is a strong inquiry; and it is believed for legitimate business. It is reported that some dealers have been seriously caught, owing to the unexpected shortness of stocks, and the indifference of sellers. The following may be taken as the average prices paid: East coast ports, £10 1s. 3d.; west coast ports, £10 2s. 6d.; south coast ports, £10, less 3½ per cent.

COAL TRADE REPORTS.

From Our Own Correspondents.

Lancashire Coal Trade.—An active demand is reported for all descriptions of fuel except the better qualities of round coal. These still hang somewhat on the market, but are moving off in sufficient quantity to take away the present output. Prices are firm at the full list rates. Best Wigan Arley averages 11s. to 11s. 6d. per ton at the pit; Pemberton four-feet and seconds Arley, 9s. 6d. to 10s. 6d.; and common house coal, 8s. to 8s. 6d. The lower class round coals are in brisk demand; and though rather more plentiful supplies are offering, owing to the quietness in house coals, there is no surplus on the market. From 7s. 9d. up to 8s. 3d. and 8s. 6d. per ton at the pit, according to quality, is being secured for steam and forge descriptions. For engine fuel there is a pressing inquiry, especially for forward contracts; and some large quantities have recently been placed at advances of from 6d. to 8d. per ton over last year's rates. The inferior sorts are not quite so strong as the better qualities; and a large contract has been settled at 3d. per ton over last year. But the principal firms in the Manchester district are asking 8d. per ton above last year's rates; and generally contracts for good qualities of slack could not be placed at anything within 6d. per ton above the prices at which they were taken twelve months ago. At the pit mouth, common slack averages 3s. 6d. per ton; good medium, 4s. to 4s. 9d.; and best qualities, 5s. to 5s. 6d. For shipment, there is a steady inquiry; but business is a good deal interfered with not only by the increase in freights, but also owing to the difficulty in obtaining vessels at the Mersey ports. Delivered at the Garston Docks or the High Level, Liverpool, ordinary steam coals average 9s. to 9s. 6d. per ton.

Northern Coal Trade.—The coal trade of this district has been irregular for the last few days; steamships having been delayed. This, and the falling off of the Baltic trade, has caused some reduction in the price of coals, more especially of steam qualities. Best Northumbrian steam coals are about 9s. 3d. per ton f.o.b.; steam smalls, 5s. 6d.; and second qualities, 8s. 6d. Gas coals are firm, though the quotations vary much with different collieries, according to position and extent of the output that is contracted for. The deliveries on contract are now at about the highest point of the year; and thus the coal for sale beyond these contracts is only limited in amount, and commands rather high prices for the best qualities. Generally, the quotation for best Durham gas coals, for occasional cargoes, is from 9s. 3d. to 10s. 6d. per ton f.o.b.; but one or two coal owners who have heavy contracts ask rather higher rates. Prices of gas coke show no change this week.

Scotch Coal Trade.—The trade suffered from a long-continued and widespread fog, which so interfered with carriage, both by land and sea, that in some instances collieries were stopped working simply because they could not get their output sent away. Freights have also been ruling high. These two causes have had a depressing effect upon prices. The quotations are: Main, 8s. per ton f.o.b. Glasgow; ell, 8s. 6d. to 8s. 9d.; and splint, 8s. 9d. to 9s. The shipments for the week were 154,506 tons—a decrease of 22,902 tons on the previous week, and of 15,839 tons on the corresponding week of last year. For the year to date, the total shipments have been 8,351,492 tons—an increase of 1,429,971 tons upon the same period of last year.

The Lighting Question at Downham Market.—At the last meeting of the Downham Market District Council, the Clerk (Mr. H. Wayman) reported at some length on the position of the Council and the Gas Company as to the removal of the lamp-posts not now in use, and stated that he thought the Council could not compel the Gas Company to remove them—the Company having acquired statutory powers. The Commissioners, under the Downham Improvement Act, had given the Company permission to lay mains and put up lamp-posts for the public lighting of the town; and until the Council had obtained a Provisional Order to erect works for the supply of gas to the public and for lighting the town, they could not compel the Company to remove the posts. He subsequently stated that steps would be taken, on behalf of the Council, to obtain an Order to erect gas-works, and that the necessary notice had been given to the Company.

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More Trouble at Llanelly.—Reports reach us that another labour trouble is imminent at the Llanelly Gas-Works. The Manager has received demands for an advance of 9d. per day for stokers, and 6d. for the lamplighters, besides which a dispute is pending respecting two workmen under notice.

West Bromwich Gas Supply.—The West Bromwich Corporation Gas Department report that the sales of gas for the Michaelmas quarter were 43,944,400 cubic feet, and that the amount of the gas-rental (including public lighting) was £6333; showing an increase of about 11½ per cent. over the corresponding quarter of last year. This is attributed largely to the introduction of the penny-in-the-slot system. It is expected that it will soon be necessary to extend the productive capacity of the works. There are at present 3000 customers using prepayment meters; and they are consuming about 13 million cubic feet of gas per annum.

A New Water Supply for Workington.—A special meeting of the Workington Town Council was held last Thursday, for the purpose of considering what means should be taken to improve the present intermittent water supply. Two schemes for drawing water from Crummock Lake were before the Council, one to take 3 million gallons per day, estimated to cost £160,000, and the other to take 1 million gallons per day, at an estimated cost of between £60,000 and £70,000. After a long discussion, it was unanimously resolved to adopt the smaller scheme, and to promote a Bill in the next session of Parliament to obtain the necessary powers and to purchase the undertaking of the Cockermouth and Workington Joint Water Committee.

A New Coalfield.—Coal pits are about to be sunk at Himley, on land belonging to the Earl of Dudley. Instructions to at once proceed with the work of sinking a shaft have been given by the Earl to Alderman Claughton and his Chief Mining Engineer—Mr. John Hughes—whose discovery in 1894 of a fault, of a peculiar geological formation, at No. 7 pit of the Himley Colliery (thus giving proof of the existence of coal on the other side of the great western boundary) led to the present undertaking being started. The area of the expected new coalfield is about 1000 acres. In the event of this field being successfully and fully "discovered," it is proposed to put down a colliery plant on the most modern principles, at a cost of about £150,000.

Incandescent Gas Lighting at Hornsey.—The Surveyor to the Hornsey District Council (Mr. E. J. Lovegrove) recently reported to the Lighting Committee that the cost of fitting up No. 8 district for the incandescent system would be as follows: 113 lamps fitted with 3½-feet suspension frame fittings as now in use, including alteration to lanterns, £145; or 113 lamps fitted with new 3-feet burners as recently fixed in Southwood Lane, including alteration to lanterns, £135. The saving in maintenance and lighting on the basis of the Surveyor's report would in the first instance be £14 per annum, and in the second £58 per annum. With either system, the increased cost of attendance would be about 15s. a week. The Committee recommended that the second of the alternative proposals of the Surveyor should be adopted; and this has been agreed to by the Council.

Projected Extension of the Leigh (Lancs.) Gas-Works.—Large extensions are about to be made at the gas-works of the Leigh District Council. The Council applied for a loan of £25,000; and the Local Government Board have sanctioned the borrowing of £18,860, but have excluded from the amount applied for sums of £5904, £100, and £136, representing the debt outstanding upon the retorts, the retort-house, and the chimney-stack, to be superseded. The Chairman and Vice-Chairman of the Gas, Water, and Electricity Committee, with the Clerk and Gas Manager, are to wait upon the Local Government Board with respect to the matter. The following tenders have been accepted, subject to the Board's sanction: J. W. Cowburn, Leigh, for works required in connection with the erection of the new retort-houses, &c. (£5166); and Messrs. Graham, Morton, and Co., Limited, for the new carbonizing and coke-storage plant (£16,167).

Oriental Gas Company, Limited.—In the report of the Directors of this Company which will be presented at the ordinary general meeting of shareholders to-morrow, they state that the business of the Company made satisfactory progress in the year ending June 30 last; the gas-rental showing a moderate increase over the corresponding item for the previous year. The revenue produced by the sale of residual products was favourably affected by the recovery of the coke market from the depression which had characterized it. As regards the expenditure, the arrangements made by the Directors in relation to the purchase of coal resulted in a reduction in the cost of the quantity carbonized; and the rates of exchange ruling for the financial year were rather better. The balance of the general revenue account (after payment of the interim dividend of 3½ per cent. in June last, and after carrying £4500 to the reserve and depreciation account) is £32,992, out of which the Directors recommend the payment of a dividend of 4½ per cent., free of income-tax, making a total dividend of 8 per cent. for the year, and leaving a balance of £19,492 to be carried forward.

Serious Explosion at the Saltley Gas-Works.—Shortly before eight o'clock last Sunday morning, an alarming explosion took place at the Saltley Gas-Works, Birmingham. According to the report in the "Birmingham Daily Post," it was due to the breakage of a cylinder cover in one of the exhauster-houses; and the gas escaping under pressure catching fire, an explosion resulted. The building was enveloped in flames, the windows were blown out, and much damage was done to the doors and other woodwork. Two workmen were in the house at the time, and were somewhat badly burned. "First aid" was rendered by members of the Birmingham Fire Brigade, who were promptly on the scene; and the injured men were conveyed to the General Hospital. Mr. Morrison, who has the supervision of the station, also sustained slight injury to the hands. Useful work was done by the hose belonging to the establishment; and on the arrival of the Fire Brigade the flames were speedily extinguished. Immediately after the explosion, Mr. Morrison took the necessary steps to prevent any further flow of gas to the building. By this promptitude of action, the danger of the fire spreading to the meter and governor house adjoining was avoided. The Engineer (Mr. H. Hack) visited the premises shortly after the occurrence, and approved of the course adopted.

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JOHN NICHOLSON & SONS, Limited, Chemical Works, Leeds, specially produce this ACID from SULPHUR, for making SULPHATE OF AMMONIA of high quality and *good* colour. Delivery in our own Railway Tank-Wagons or Carboys. Highest references and all particulars supplied on application.

PORTER & CO., Gowts Bridge Works, LINCOLN, Engineers, Ironfounders, and Contractors for the erection of Gas-Works for Towns, Villages, Mansions, Manufactories, Collieries, and Isolated Buildings at home and abroad. Manufacturers of Retorts and Fittings, Condensers, Scrubbers, Purifiers, Valves, &c.; also of Girders, Wrought and Cast Iron Tanks, Iron Roofs, &c.

Telegraphic Address: "PORTER LINCOLN."

[For Illustrated Advertisement, see Nov. 1, p. 998.]

SADLER & CO., Ld., Middlesbrough; ULVERSTON (BARROW); PORTSMOUTH; CARLTON (N.E.R.); and STOCKTON. Tar and Petroleum Distillers. Benzol and Petroleum Spirit, 700 and other Gravities specially prepared for Carburetting. SOLAR OIL for Gas Making, Kerosene, &c.

Correspondence invited.

Telegraphic Address: "SADLER, MIDDLESBROUGH."

AMMONIACAL LIQUOR wanted.

BROTHERTON AND CO., Ammonia Distillers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

GAS CARBON Wanted, not less than 4-Ton Loads.

Apply to the BRIMINGTON CARBON COMPANY, Sowerby Bridge, YORKS.

IMPORTANT.

REPAIR your old Retorts with Patent STICKFAST FIRE CEMENT. Unequalled for Repairing Inclines. Estimates for all kinds of Retort-Settings.

Write CROWTHER, Retort Setter, and Sole Maker of Stickfast Fire Cement, Manor Street, HUDDERSFIELD.

PATENTS FOR INVENTIONS.

J. C. CHAPMAN, M.I.M.E., and Fel. Chartered Inst. Patent Agents. ADVICE ON ALL MATTERS CONNECTED WITH ABOVE. Information and Handbook on application.

70, CHANCERY LANE, LONDON, W.C.

WANTED, Carbon in 4 Ton Lots, or more; also OIL CARBON.

State Price, f.o.r. at nearest Station, to No. 3031, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

SULPHATE OF AMMONIA SATURATORS.

JOSEPH TAYLOR & CO., Chemical Plumbers, &c., and Makers of every description of Solid Plate Lead and Timber Cased Saturators, &c., CENTRAL PLUMBING WORKS, TOWN HALL SQUARE, BOLTON. Special attention to Repairs.

Before placing Orders, please write for Estimate.

Telegraphic Address: "SATURATORS, BOLTON."

GAS PURIFICATION.

OXIDE OF IRON BOG ORE.

BALE & CO.'S Oxide of uniform quality. SPECIAL FIRE CEMENT, OXIDE PAINTS OILS, SULPHURIC ACID, &c.

120 and 121, NEWGATE STREET, LONDON, E.C.

Telegrams: "BOGORE, LONDON."

SPENT OXIDE wanted.

BROTHERTON AND CO., Chemical Manufacturers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

CANNEL, COAL, ETC.

JOHN ROMANS & SON, EDINBURGH, Gas Engineers, supply all the most approved SCOTTISH CANNELS; also FIRE-CLAY GOODS, CAST-IRON PIPES, and other APPARATUS for GAS and WATER WORKS.

Prices, &c., will be forwarded on application to No. 30, ST. ANDREW SQUARE, EDINBURGH, NEWTON GRANGE, NEWBATTLE, DALKEITH, } SCOTLAND.

GAS PLANT for Sale—I can always offer NEW and SECOND-HAND GAS APPARATUS, including Retorts and Fittings, Condensers, Exhausters, Scrubbers, Washers, Purifiers, Gasholders, Tanks, Valves, Connections, &c. Also a few COMPLETE WORKS. **Compare Prices and Particulars before ordering elsewhere.**

J. F. BLAKELEY, Gas Engineer, Ravensthorpe, YORKS.

DRAUGHTSMAN wanted in Contractors' Office in the North of England. Accustomed to designing and detailing Gas-Works Apparatus.

Apply, stating Age, Terms, and References, to No. 3158, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, as Chemist in a Tar and Ammonia Works, a YOUNG MAN who has had a sound Scientific Training. State Age, Qualifications, Salary required, and when at liberty.

Address No. 3161, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, two good Stokers used to Shovel Charging, Generator Furnaces, Engine and Exhauster. Permanency. Abstainer preferred. Wages 30s. 6d. per week. Eight-hour shifts.

Apply, with References, to J. A. GRAY, Gas-Works, CLEATOR MOOR.

LUDLOW UNION GAS COMPANY.

WANTED, a respectable Man as Gas-FITTER. Must be well up in both Iron and Compo. and Fitting generally, and fixing Meters, Stoves, &c.

Apply, with References, stating Age, whether Married or Single, previous Experience, and Salary required. One who is willing to make himself generally useful preferred.

W. H. WHITEHOUSE, Manager.

NEW SWINDON GAS COMPANY.

WANTED, a Works Foreman (age between 30 and 40). Thorough, practical experience in all the departments of Gas Manufacture required. Must possess full knowledge of Sulphate Making and Water Gas. Used to control of Workmen. Will be required to live on the Works.

Apply, stating Wages, and enclosing *copies* of not more than three Testimonials to the undersigned, not later than Saturday, the 26th inst.

JOHN J. JERVIS, Engineer.

Gas-Works, New Swindon.

GWYNNE & BEALE'S

PATENT

GAS-EXHAUSTERS AND STEAM-ENGINES

FOR FULL PARTICULARS, APPLY TO THE MAKERS:

GWYNNE & CO.,

Telegrams: "GWYNNEGRAM, LONDON."

HYDRAULIC AND GAS ENGINEERS

(Late Essex Street Works, Victoria Embankment, London),

Telephone No. 95 Holborn.

BROOKE STREET WORKS, HOLBORN, LONDON, E.C.

GAS AND WATER WORKS.

THE Ambleside Urban District Council require a competent MANAGER for their Gas and Water Works.

The successful candidate will be required to devote the whole of his time to the duties of his office, and to superintend the work of a Clerk who will be appointed to keep the Books and collect the Accounts.

The Salary will be £125 per annum, such sum to include everything. Neither House, Coal, nor Gas will be provided.

All applications must be made by letter to the undersigned, enclosing Testimonials, not later than the 30th inst.

Personal canvassing of the members is strictly prohibited.

GEORGE GATEY,
Clerk to the Council.

Ambleside, Nov. 10, 1898.

FOR SALE, at the Gas-Works, Whitchurch, Hants—A STATION METER by the Gas-Meter Company, passing 1300 feet per hour, 10 feet per revolution, with all necessary Valves for bye-passing and 4-inch Connections. Also GOVERNOR complete, with 4-inch Connections and Bye-Pass Valves, in working order. Purchaser to remove same at his own cost.

Offers to be sent to W. A. SCHULTZ, F.C.A., Secretary, 46, Cannon Street, LONDON, E.C.

GUILDFORD GASLIGHT AND COKE COMPANY.

TENDERS FOR SULPHURIC ACID.

THE Directors of the above Company invite TENDERS for the supply of Pure BRIMSTONE ACID for the manufacture of Sulphate of Ammonia for a period of One Year from the 1st day of January, 1899.

For further Particulars, apply to the undersigned.

Sealed Tenders, endorsed "Tender for Acid," addressed to D. Williamson, Esq., J.P., Chairman of the Gas Company, must be delivered not later than Dec. 1, 1898.

WILLIAM TITLEY,
Secretary.

Gas Offices, Guildford,
Nov. 9, 1898.

NEW HUNSTANTON URBAN DISTRICT COUNCIL.

CONTRACT No. 4.

THE above-named Council invite TENDERS for the supply of one of Messrs. W. & B. COWAN'S PATENT GAS GOVERNORS, with Stationary Syphon and with Inlet, Outlet, and Bye-Pass Valves and Pipes, 8 inches in diameter, erected complete at their Gas-Works, at Hunstanton.

Sealed Tenders, endorsed "Tender for Gas Governor," are to be forwarded to the undersigned not later than the 23rd of November inst.

J. S. B. GLASIER,
Clerk.

Hunstanton, Nov. 10, 1898.

CORPORATION OF LEICESTER.

RETORTS AND FIRE-BRICKS.

THE Gas and Electric Lighting Committee of the above Corporation are prepared to receive TENDERS for the supply and delivery of RETORTS and FIRE-BRICKS.

Specification, Quantities, and Form of Tender can be obtained from the Engineer.

Tenders, addressed to Alderman Lennard, Chairman, and endorsed "Tender for Retorts, &c.," to be delivered at these Offices not later than Eleven o'clock a.m., on Saturday, Nov. 19, 1898.

The Committee do not bind themselves to accept the lowest or any Tender.

ALFRED COLSON, M.Inst.C.E.,
Engineer and Manager.

Offices: Millstone Lane,
Leicester, Nov. 3, 1898.

THE GASLIGHT AND COKE COMPANY.

SALE, BY AUCTION, OF
£187,500 ORDINARY STOCK.

IN Pursuance of The Gaslight and Coke Company Act, 1876, and of The Gaslight and Coke Company's (Capital Consolidation) Act, 1898, Notice is Hereby Given that it is the intention of the Directors of this Company to SELL BY AUCTION, at the Auction Mart, Tokenhouse Yard, in the City of London, on Tuesday, the 6th day of December next, at Two o'clock p.m., £187,500 of ORDINARY STOCK of the Company, to be issued under the Powers of the Company's said Act of 1898, and to be paid up in full on or before the 2nd of January next.

By order,
JOHN WILLIAM FIELD,
Secretary and General Manager.

Chief Office: Horseferry Road,
Westminster, S.W., Nov. 9, 1898.

SUNDERLAND AND SOUTH SHIELDS WATER COMPANY.

IMPORTANT SALE OF WATER STOCK.

TO BE SOLD, by Auction, in the Long Room of the Queen's Hotel, Fawcett Street, Sunderland, on Wednesday, Nov. 23, 1898, at Half-past Three o'clock in the Afternoon,

Mr. ATKINSON GIBSON, Auctioneer,

£25,000

(Nominal) of the New Stock (Maximum Dividend 5 per cent.) authorized to be created and issued under the Powers contained in the Sunderland and South Shields Water Act, 1891.

The above Stock will be entitled to Dividend from the 1st day of January, 1899, and be registered in the name of the Purchaser free of charge.

A Deposit of 10 per cent. will be required at the time of Sale; the remainder to be paid on or before the 3rd day of January, 1899.

SALES BY AUCTION OF GAS AND WATER STOCKS AND SHARES.

MR. ALFRED RICHARDS begs to notify that his AUCTIONS of STOCKS and SHARES in London, Suburban, and Provincial Gas and Water Companies are held MONTHLY, at the Mart, Tokenhouse Yard, E.C.

He also undertakes the issuing by Auction of Gas and Water Stocks and Shares under Parliamentary Powers.

Terms for issuing such Capital, and also for including Gas and Water Stocks and Shares in these periodical Sales, can be obtained on application at Mr. Alfred Richards's Offices, 18, FINSBURY CIRCUS, E.C.

By order of the Directors of

THE GASLIGHT AND COKE COMPANY.

ISSUE OF £187,500 ORDINARY STOCK.

MR. ALFRED RICHARDS will Sell BY AUCTION, at the Mart, Tokenhouse Yard, London, E.C., on Tuesday, Dec. 6, 1898, at Two o'clock precisely, in Lots,

£187,500 OF ORDINARY STOCK OF
THE GASLIGHT AND COKE COMPANY.

This Stock, which is issued under the Provisions of The Gaslight and Coke Company's Act of 1893, ranks for a Standard Dividend of 4 per cent., subject to the Sliding-Scale, and in view of the last distribution on the Company's issued "A" Ordinary Stock would be entitled to receive a Dividend at the rate of £4 18s. per cent.

Particulars may be obtained at the OFFICES OF THE COMPANY in Horseferry Road, WESTMINSTER, S.W.; and of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Directors of the

BRENTFORD GAS COMPANY.

£15,000 OF NEW STOCK 1881.

Ranking for a Standard Dividend of 7 per cent. per annum, subject to the Sliding-Scale; the last Dividend on similar Stock having been at the rate of 9 per cent.

MR. ALFRED RICHARDS will Sell THE ABOVE BY AUCTION, at the Mart, Tokenhouse Yard, E.C., on Wednesday, Nov. 23, at Two o'clock precisely, in Lots.

Particulars may be obtained of the SECRETARY of the Company, at the Offices, BRENTFORD; and of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Directors of the

SOUTHEND GAS COMPANY.

NEW ISSUE OF £13,500 FIVE PER CENT. STOCK.

Ranking for a Standard Dividend of 5 per cent. subject to the Sliding Scale; but in view of the Dividends paid in June last entitled to pay 5½ per cent.

MR. ALFRED RICHARDS will Sell THE ABOVE BY AUCTION, at the Mart, E.C., on Tuesday, Nov. 29, at Two o'clock, in Lots.

Particulars at the Company's Offices, SOUTHEND; and of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

MR. ALFRED RICHARDS will also include in the above Sale on the 29th of November Shares in the

GREAT YARMOUTH WATER-WORKS COMPANY,
SOUTH-WEST SUBURBAN WATER COMPANY, and the
BARNET DISTRICT GAS AND WATER COMPANY.

Particulars of the AUCTIONEER as above.

By order of the Directors of the

NORTH MIDDLESEX GAS COMPANY.

500 £10 ORDINARY SHARES.

Ranking for a Standard Dividend of 7 per cent., subject to the Sliding-Scale—the last Dividend on similar Shares having been at this rate.

MR. ALFRED RICHARDS will Sell THE ABOVE BY AUCTION, at the Mart, E.C., on Tuesday, Dec. 13, at Two o'clock, in Lots.

Particulars of Messrs. MERRIMAN, PIKE, AND MERRIMAN, Solicitors, 25, AUSTIN FRIARS, E.C.; and of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

---

131 £10 "B" SHARES (FULLY PAID) IN

THE BOURNEMOUTH GAS AND WATER COMPANY.

Ranking for a Maximum Dividend of 7 per cent.

MR. ALFRED RICHARDS will Sell THE ABOVE BY AUCTION, at the Mart, E.C., on Tuesday, Dec. 13, at Two o'clock, in Lots.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

GEORGE A. CHAPMAN.

STOCK AND SHARE DEALER,
51, MOORGATE STREET, LONDON, E.C.

SHARES ON SALE—£400 Northfleet and GREENHITHE GAS COMPANY'S STOCK; £700 of the 4 per cent. DEBENTURE BONDS in the HENLEY-ON-THAMES WATER COMPANY, Limited; a few SHARES in the WESTERHAM GAS AND COKE COMPANY; 20 £10 fully-paid, 7 per cent. "B" SHARES in the HORSHAM GAS COMPANY, Limited, and 15 £10 fully-paid "A" SHARES in the same Company; 100 ORDINARY and 80 PREFERENCE SHARES in METERS LIMITED.

WANTED, SHARES in METERS LIMITED, Ordinary and Preference, and also SHARES in GAS and WATER COMPANIES.

ALL CLASSES OF GAS AND WATER SHARES DEALT IN.

CARDIFF GASLIGHT AND COKE COMPANY.

(INCORPORATED 5TH MAY, 1837.)

THE Directors of the Cardiff Gaslight and Coke Company Hereby Give Notice that they are prepared to receive, not later than Thursday, the 1st of December, 1898, Sealed TENDERS for

£10,000 "D" STOCK,

bearing a Maximum Dividend of 5 per cent. per annum, in pursuance of the Powers of the Cardiff Gas Act, 1887.

Conditions and Forms of Tender, together with further Information, may be obtained on application to the undersigned.

By order,
GEORGE CLARRY,
Secretary.

Gas Office, Cardiff,
Oct. 12, 1898.

LIVERPOOL UNITED GASLIGHT COMPANY.

SALE OF NEW SEVEN PER CENT. STOCK.
TO BE SOLD BY AUCTION BY

MESSRS. BRANCH AND LEETE on Tuesday, the 13th day of December, 1898, at Twelve o'clock noon precisely, at the Law Association Rooms, Cook Street, in Liverpool, subject to the Conditions of Sale which will then be produced,

THE SUM OF £40,000 NEW STOCK
OF AND IN THE
LIVERPOOL UNITED GASLIGHT COMPANY

Created under the Powers of the Liverpool United Gaslight Company's Act, 1896.

The Stock will be offered in Lots of the nominal amount of £100 each, and will be issued to each purchaser as paid up Stock, after full payment of the purchase money.

For further Particulars, apply to Mr. J. F. ROBINSON, Treasurer, Gas Office, Duke Street; or to Messrs. GARNETT, TARBET, AND CO., Solicitors, Queen Insurance Buildings, Castle Street, LIVERPOOL.

THE SOUTH SHIELDS GAS COMPANY.

IMPORTANT SALE OF GAS STOCK.

MR. M. STAINTON is instructed by the Gas Company to SELL BY PUBLIC AUCTION, in the Board-Room, at the Gas Offices, Chapter Row, South Shields, on Monday, the 5th of December, 1898, at One o'clock p.m., prompt, £8000 of NEW STOCK, under the South Shields Gas Act, 1886.

The Stock will be put up in Lots of £100 each, nominal value. A Deposit of £10 per cent. to be paid on the purchase money at the Sale; the remainder to be paid to the Company's Bankers, the North-Eastern Banking Company, Limited, King Street, South Shields, on or before the 31st of December next.

The Stock will rank for Dividend from the 1st of January, 1899.

The Stock will be registered in the name of the Purchaser free of expense.

By order of the Directors,
J. H. PENNEY,
Secretary.

Gas Offices, Chapter Row,
South Shields, November, 1898.

SECOND EDITION, Revised and Enlarged, with NEW SECTION on ACETYLENE.

Numerous Illustrations. Handsome Cloth, 10s. 6d.

GAS MANUFACTURE
(THE CHEMISTRY OF).

A Hand-Book on the Production, Purification, and Testing of Illuminating Gas, and the Assay of the Bye-Products of Gas Manufacture. For the Use of Students.

BY

W. J. ATKINSON BUTTERFIELD, M.A., F.I.C., F.C.S.,
Formerly Head Chemist, Gas-Works,
Beckton, London, E.

"The **best work** of its kind which we have ever had the pleasure of reviewing."—*Journal of Gas Lighting.*

"Amongst works not written in German, **we recommend before all others, Butterfield's Chemistry of Gas Manufacture.**"—*Chemiker Zeitung.*

*** This work deals primarily with the ordinary processes of GAS MANUFACTURE employed in this country, and aims especially at indicating the *principles* on which they are based. The more modern, but as yet subsidiary, processes are fully treated also.

The Chapters on **Gas Analysis** and **Photometry** will enable the consumer to grasp the methods by which the quality of the gas he uses is ascertained; and in the Chapter on **The Applications of Gas**, not only is it discussed as an illuminant, but also as a ready source of heat and power.

The **Incandescent Gas-Light** is dealt with in an exhaustive manner; and the latest theories of its physical basis, as well as the practical developments of lighting by **Incandescence**, are thoroughly discussed.

In Chapter X. an attempt has been made to trace in a readily-intelligible manner the extraction of the principal derivatives from the crude BYE-PRODUCTS.

The work deals incidentally with the most modern features of the industry, including *inter alia* the commercial production and uses of **Acetylene**, to which a special Chapter is devoted in the new Edition, and the application of **Compressed Gas** for Street Traction. The needs of the Students in Technical Colleges and Classes have throughout been kept in view.

LONDON:
CHARLES GRIFFIN & CO., Ld., Exeter St., STRAND.

Now Ready, Price 15s., Limp Cloth, the

EIGHTEENTH YEARLY

ANALYSIS OF THE ACCOUNTS

OF THE

METROPOLITAN WATER COMPANIES,

Chelsea, East London, Grand Junction, Kent, Lambeth, New River, Southwark and Vauxhall, and West Middlesex—showing the Capital, Income, Expenditure, Profits, and Dividends per Million and per Thousand Gallons of Water supplied; the proportion of Expenditure and Profits to Gross Income; and the Income, Expenditure, and Profits per House, &c., supplied for the Year ended Dec. 31, 1897, or March 31, 1898, together with the Quantity of Water supplied, the estimated Daily Quantity supplied for Domestic and other Purposes, the Quantity supplied per Head of Population, &c., &c., for the Year ended Dec. 31, 1897.

Compiled and arranged by

ALFRED LASS, F.C.A.

LONDON:

WALTER KING, 11, Bolt Court, FLEET STREET, E.C.

INCANDESCENT GAS LIGHTING.

Incandescent Burners from **5/6 per doz.**

Specially annealed best Fireproof Glass Chimneys (equal to the Jena.) **1/4** per Doz.

All other Incandescent Fittings at greatly reduced Prices.

Best "Comet" Bulbs, 3s. per Dozen.

Write for Illustrated Price Lists.

WHOLESALE FITTINGS COMPANY,

80, COMMERCIAL ROAD, LONDON, E.

THOMAS DUXBURY & CO.,
16, DEANSGATE, MANCHESTER.

Best Gas Coal and Cannel, giving High Illuminating Power, Large Yield per ton, and reasonable in Price.

Telegrams: "DARWINIAN, MANCHESTER." Telephone 1806.

COKE-BREAKERS,

PRICES REDUCED.

(THOMAS & SOMERVILLE'S PATENT)

With Elevators and Conveyors worked by Steam or Gas Engine.

GEORGE WALLER & CO.,
165, QUEEN VICTORIA STREET, E.C.
And at STROUD, GLOUCESTERSHIRE.

THE Acetylene Illuminating Company, Limited, 63, Queen Victoria Street, London, E.C., GIVE NOTICE that they hold the BRITISH PATENT RIGHTS for the MANUFACTURE OF CALCIUM CARBIDE by means of the electric furnace, that they are bringing an action against the Midland Acetylene (Parent) Syndicate, Limited, to restrain them from so manufacturing that product, and that they intend in the future to bring actions against all infringers of these Patents and all purchasers or users of Carbide of Calcium made in infringement of the same.

NOTICE.

THE Acetylene Illuminating Company, Limited, having published and issued an advertisement or circular claiming that they hold the British Patents for the Manufacture of Calcium Carbide by means of the Electric Furnace, we guarantee to indemnify anyone who buys Carbide from us against any claim by "The Acetylene Illuminating Company, Limited," or anyone else.

READ HOLLIDAY AND SONS, LIMITED, Acetylene Gas Engineers and Carbide of Calcium Manufacturers, HUDDERSFIELD.

NOTICE.

THE Acetylene Illuminating Company, Limited, having published and issued an advertisement or circular claiming that they hold the British Patents for the Manufacture of Calcium Carbide by means of the Electric Furnace, we guarantee to indemnify anyone who buys Carbide from us against any claim by "The Acetylene Illuminating Company, Limited," or anyone else.

TINKER AND HOLLIDAY, LIMITED, Carbide of Calcium Manufacturers, HAZELHEAD, SHEFFIELD.

NEWBATTLE CANNEL.

Highest Results in Gas, & Excellent Coke.

QUOTATIONS ON APPLICATION TO

THE LOTHIAN COAL COMPANY,
LIMITED,
NEWBATTLE COLLIERIES,
DALKEITH, N.B.

ENRICH YOUR GAS

WITH

CHEAP BENZOL.

A T to-day's Price of Benzol, Illuminating POWER costs less than ONE-THIRD OF A PENNY PER CANDLE.

Apply to SADLER & CO., MIDDLESBROUGH.

DISPENSE WITH CANNEL COAL

and

INCREASE YOUR ILLUMINATING POWER

by using the

WHESSOE-MUNICH BENZOL CARBURETTER

The Cheapest and Best in the Market.

The Managers of Tynemouth, Middlesbrough, and Darlington Gas-Works are much pleased with it, and would not be without it.

Apply to the Sole Makers

THE WHESSOE FOUNDRY COMPANY, LIMITED
DARLINGTON.

PRICE'S COKE & COAL BARROW

effects a great saving of time, labour, and expense.

For Particulars, Price, &c., apply to Mr. EDWARD PRICE, 119, Queen's Road, FINSBURY PARK, N.

Prices are Reduced.

THE SILICA FIRE-BRICK COMPANY,

OUGHTIBRIDGE, near SHEFFIELD

MANUFACTURE

SILICA BLOCKS, BRICKS, AND CEMENT

OF SUPERIOR QUALITY

FOR GAS-FURNACES.

Trade Mark: "SILICA."

These Goods (largely used in Gas, Glass, Iron, and Steel Works) are, on account of their

GREATER DURABILITY,

Strongly recommended where EXCESSIVE HEATS have to be maintained.

NOW READY.

Foolscap 4to, pp. 535, with 239 Illustrations and Steel-Plate Engraving (as Frontispiece) of WILLIAM MURDOCH, *Inventor of Gas Lighting. Morocco Gilt, 21s.; Roan Gilt, 18s.*

THE SIXTH (AND CENTENARY) EDITION OF THE

HANDBOOK

FOR

GAS ENGINEERS and MANAGERS.

By THOMAS NEWBIGGING, M.Inst.C.E.

This Edition of the "Handbook for Gas Engineers and Managers" is a great improvement on all previous editions. Much of the text has been re-written, in order to keep the work abreast of the constant advances that are being made in the Gas Industry. About fifty additional Illustrations are given; and a Steel-Plate Engraving of William Murdoch, the Inventor of Gas Lighting.

LONDON: WALTER KING, 11, BOLT COURT, FLEET STREET, E.C.

TROTTER, HAINES, & CORBETT,

Brettell's Estate

FIRE-CLAY & BRICK WORKS,

STOURBRIDGE.

Manufacturers of GAS-RETORTS, GLASSHOUSE FURNACE & BLAST-FURNACE BRICKS, LUMPS, TILES, and every description of FIRE-BRICKS.

Proprietors of

BEST GLASSHOUSE POT & CRUCIBLE CLAY.

Shipments Promptly and Carefully Executed.

London Office: R. Cull, 84, Old Broad St., E.C.

BOLDON GAS COALS.

ANALYSIS.

Yield of Gas per ton	10,500	Cubic Feet.
Illuminating Power	16·9	Candles.
Coke	66·7	Coke.
Sulphur	0·86	Sulphur.
Ash	2·04	Ash.

For Prices, &c., apply to

W. H. PARKINSON,

THE HARTON COAL CO., LTD.,

NEWCASTLE-ON-TYNE.

Telegraphic Address: "PARKINSON NEWCASTLE."

THORNLEY GAS COALS

WORKED BY THE

WEARDALE IRON & COAL Co., Ld.

OUT OF THEIR

THORNLEY AND WHEATLEY HILL COLLIERIES.

Analysis made by

Messrs. J. & H. S. PATTINSON, *May 28, 1895.*

Yield of Gas per Ton	10,500 Cub. Ft.
Illuminating Power	16·9 Candles.
Coke (of good quality)	67·5 per Cent.
Sulphur	0·58 „
Ash	2·78 „

For Price, &c., apply to the

WEARDALE IRON & COAL Co., Ld.

QUAYSIDE, NEWCASTLE-ON-TYNE.

HOLMSIDE

GAS COALS.

Present Daily Produce over 5000 Tons.

Latest Analysis—By CHARLES PHILLIPS, Gas Examiner to Rotherham Corporation

Yield of Gas per Ton	11,205 Cubic Feet.
Illuminating Power	16 7/10 Stand. Sperm. Candl.
Coke (of good & pure quality)	13¾ Cwt. per Ton.
Sulphur	A little over 1 per Cent.
Ash	Under 1 per Cent.
Tar	163 lbs. (Avoir.) per Ton.
Ammoniacal Liquor	103 lbs. (Avoir.) per Ton.

HOLMSIDE GAS COALS are supplied to the largest Gas Companies in England and on the European Continent; London alone consuming about half the produce.

SOUTH MOOR

PELTON GAS COALS.

Present Daily Produce available 3000 Tons.

Of equal quality to the "Holmside" Coal, and also very largely used by many Gas Companies at Home and Abroad.

Both descriptions are shipped at Tyne Docks, and Dunston Staiths, River Tyne, also at North and South Docks, Sunderland.

These Coals may be bought through the Principal Merchants in England, or direct from

MR. MARK ARCHER,

HOLMSIDE & SOUTH MOOR OFFICES,

NEWCASTLE-UPON-TYNE.

WATERBLEAN PAINT

Telegrams: "EVESON, BIRMINGHAM."

EVESON FOR CANNEL

TUBES AND FITTINGS

ALL KINDS

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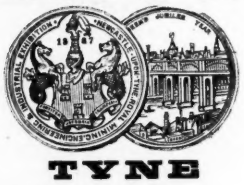

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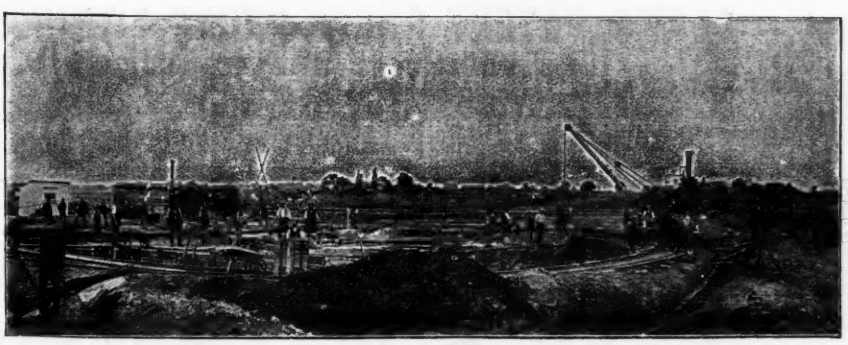

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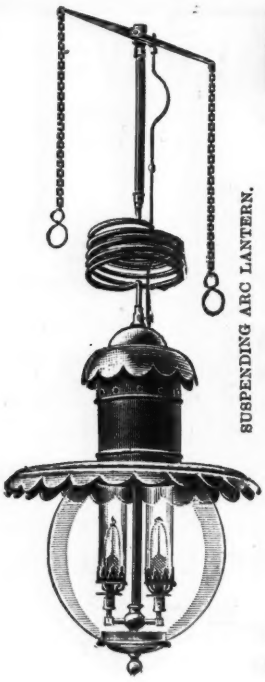

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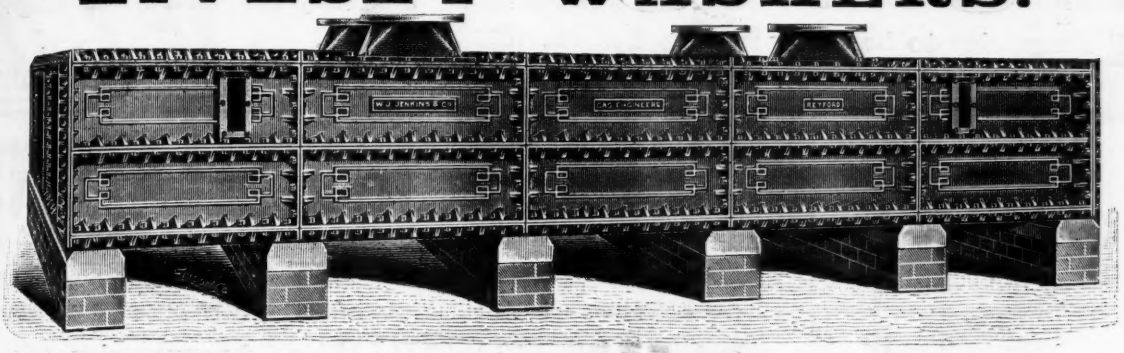

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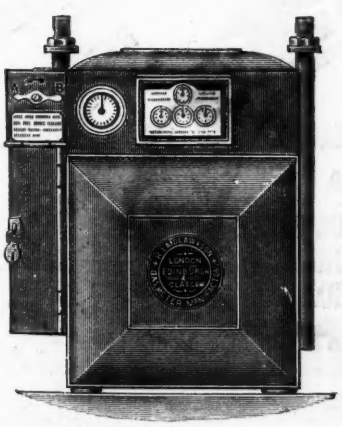

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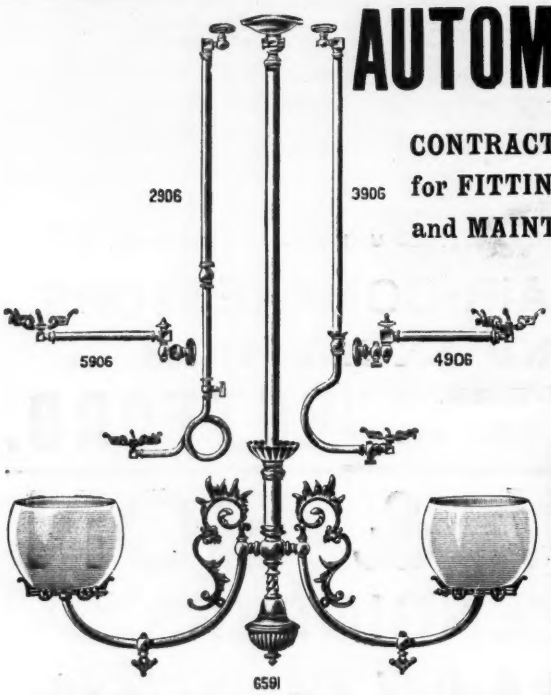

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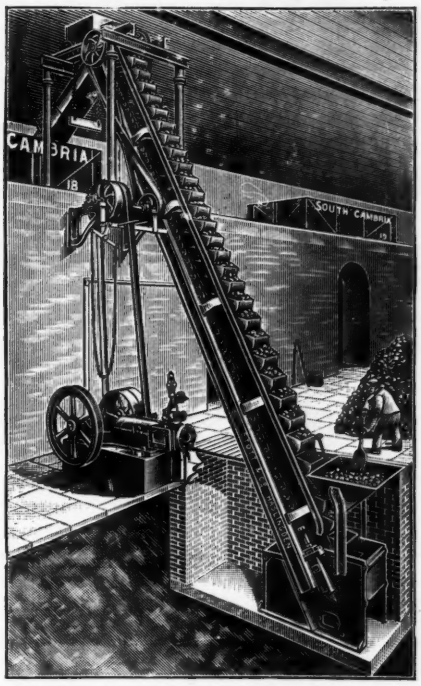

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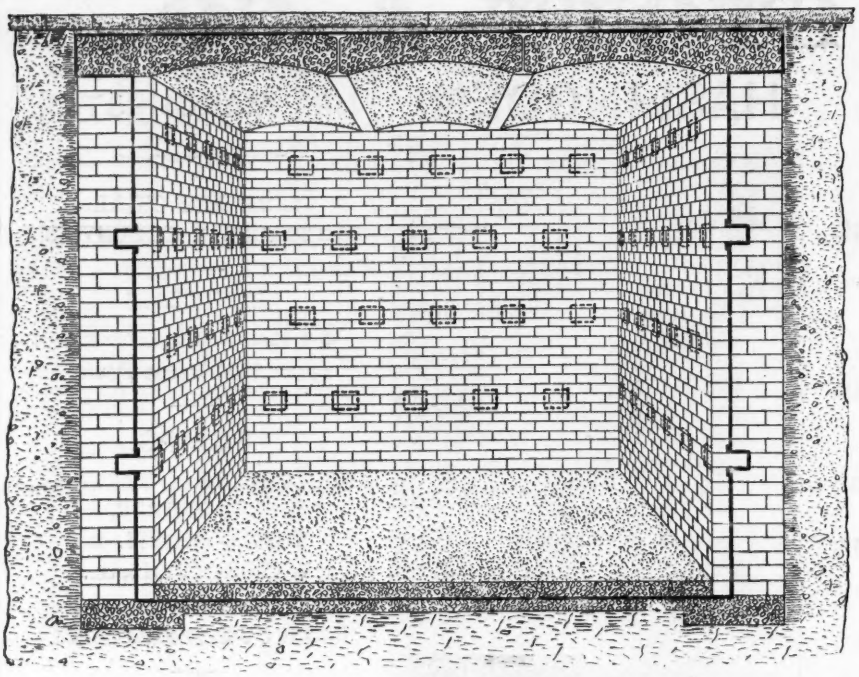

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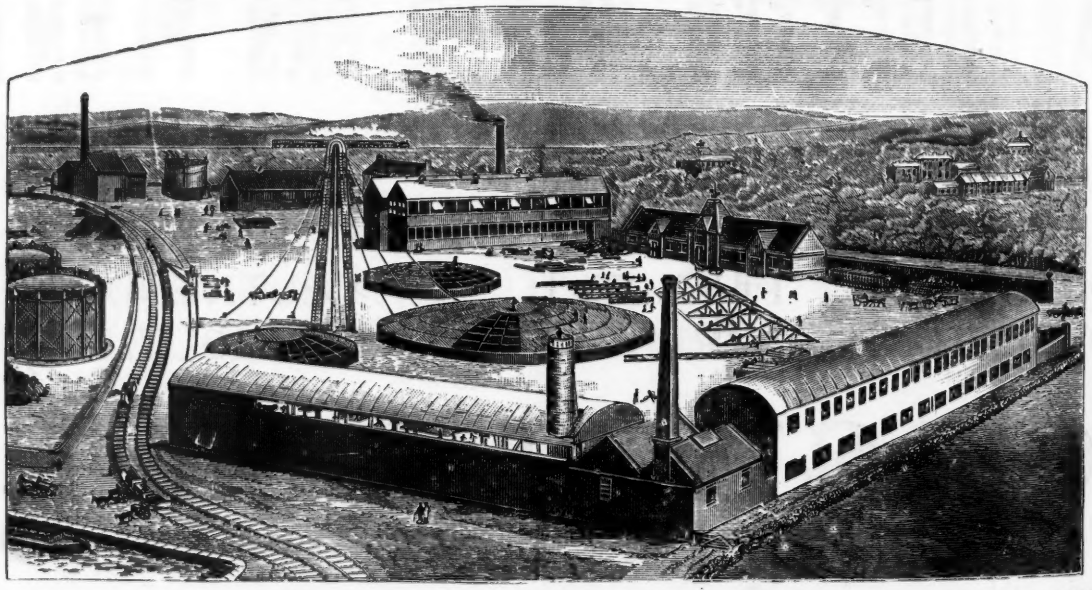

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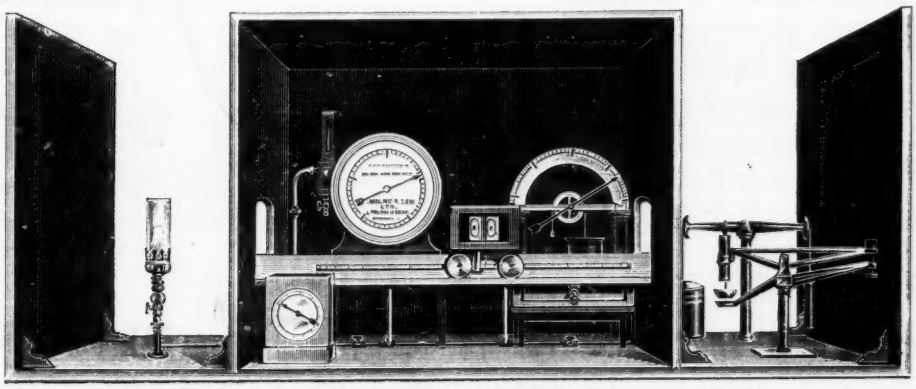

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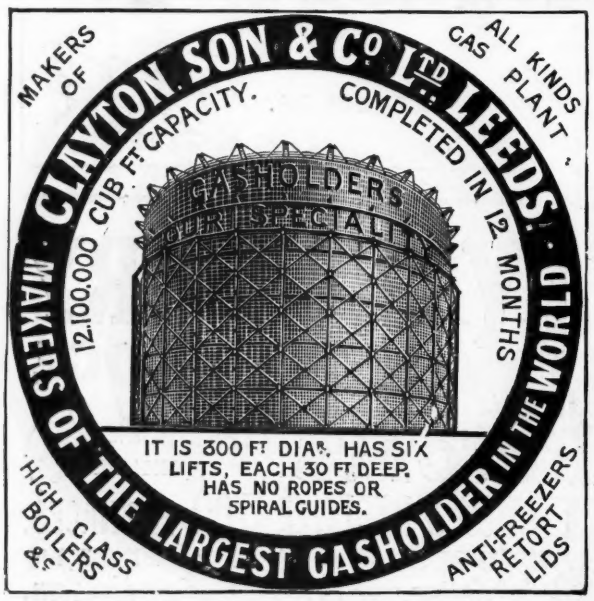
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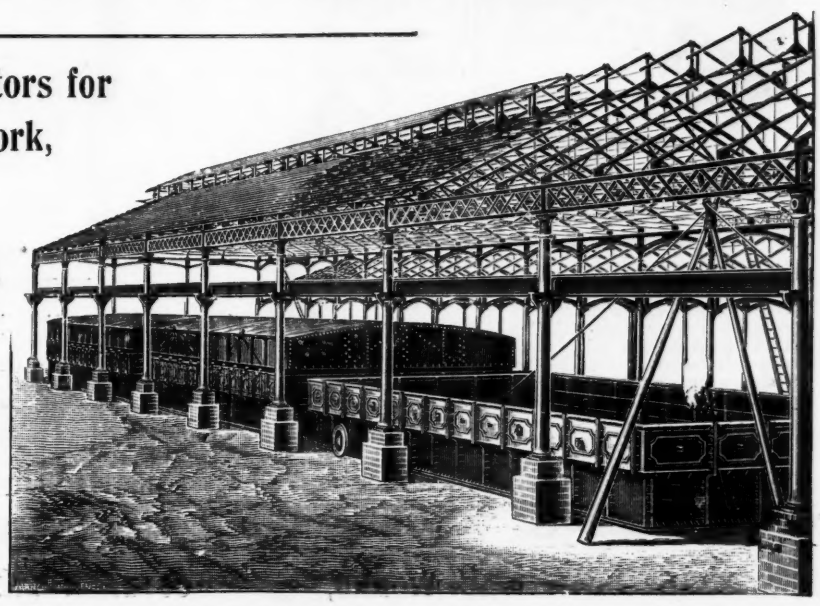
ROOFS, GIRDERS, PURIFIERS, WASHERS, SCRUBBERS, CONDENSERS, GASHOLDERS, TANKS, RETORT-MOUNTINGS, VALVES, &c., &c.



Purifiers and Roofs erected at Windsor Street Works, Birmingham, to the Designs and under the supervision of C. HUNT, Esq., M.Inst.C.E.

London Office: 165, GRESHAM HOUSE, OLD BROAD STREET, E.C.

PARKINSON'S Patent
"DRAW-PLATE" GAS-FIRES.

A Real Novelty.

Absolutely no Smell when first lit.
Invaluable for use in Bed-Rooms.
Specially adapted for Invalids and Bronchitis Patients.
Ensures a plentiful supply of Pure Air.

Adapted to most of our well-known Patterns, also to a new Pattern—

THE "CRYSTAL."

"DRAW-PLATE UP.

"DRAW-PLATE" DOWN.

SPECIAL POINTS.

Massive and Bold in Design.
Parkinson's Patent "Draw-Plate."
Art Tiles fitted at Sides and Top.
Parkinson's Patent Circulating-Burner, which does not Light Back, and produces a steady, regular Flame.
Open Canopy and Special Air-Heating Arrangement, producing a good Circulation of Pure, Warm Air.

DIMENSIONS, INCLUDING TRIVET.

Height over all	32	inches.
Width	25	"
Back to Front	10	"
Width of Fire	10½	"
Size of Flue-Pipe	3	"
Height of top of Flue from Floor	20	"

Full Description and all Particulars on application.

W. PARKINSON & CO.,

BELL BARN ROAD WORKS, **BIRMINGHAM.**

COTTAGE LANE WORKS, CITY ROAD, **LONDON.**

[See also Advt., p. 1080.

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